PROCEEDINGS.

American Fisheries Society.

1898.

MINUTES

OF THE

AMERICAN

FISHERIES SOCIETY

AT ITS

TWENTY-SEVENTH ANNUAL MEETING

HELD AT THE HOTEL MILLARD, OMAHA, NEBRASKA,
ON THE 20TH, 21ST AND 22ND DAYS
OF JULY, 1898.

SPEAKER PRINTING COMPANY,
DETROIT.

OFFICERS FOR 1898-99.

President—GEORGE F. PEABODY, Appleton, Wis.
Vice-President—WILLIAM H. BOWMAN, Rochester, New York.
Recording Secretary—HERSCHEL WHITAKER, Detroit, Mich.
Corresponding Secretary—J. E. GUNCKEL, Toledo, O.
Treasurer—L. D. HUNTINGTON, New Rochelle, New York.

EXECUTIVE COMMITTEE.

J. A. DALE, York, Pa.
E. E. BRYANT, Madison, Wis.
J. J. STRANAHAN, Put-in-Bay, O.
F. N. CLARK, Northville, Mich.
J. W. TITCOMB, St. Johnsbury, Vt.
W. L. MAY, Omaha, Neb.
DR. J. A. HENSHALL, Bozeman, Mont.

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FIRST DAY'S PROCEEDINGS.

MORNING SESSION.

At 10 o'clock a. m., July 20th, the Society was called to order by the President, Hon. W. L. May.

The following members were present:

Geo. F. Peabody, Wisconsin; Seymour Bower, Michigan; J. J. Stranahan, Ohio; J. E. Gunckel, Ohio; F. N. Clark, Michigan; James Nevin, Wisconsin; E. A. Birge, Wisconsin; Calvin Spencley, Wisconsin; W. L. May, Nebraska; W. J. O'Brien, Nebraska; Herschel Whitaker, Michigan; J. A. Dale, Pennsylvania.

The president announced that owing to a lack of time he had not prepared any formal welcoming address, and that he took pleasure in introducing Mr. James H. Adams, who would welcome the society on behalf of the City of Omaha.

Mr. James H. Adams, the secretary of the Mayor of Omaha, in well-chosen words extended a hearty welcome to the members, offering them every opportunity that could be afforded by the city officials and the Mayor's office to see the city and its industries and attractions.

Mr. Spencley responded on behalf of the Society in fitting words, expressing thanks for the courtesies extended, with a promise that the members would avail themselves of the opportunities offered.

The Treasurer being absent, Mr. Peabody was elected Treasurer pro tem.

The President announced that the next business in order was the presentation of candidates for membership, and the following were proposed:

John D. McLeod, Milwaukee, Wis.; S. L. Griffith, Danby, Vt.; A. C. Rosenburg, Kalamazoo, Mich.; George M. Brown, Saginaw, Mich.; Professor H. C. Bumpus, Providence, R. I.; George L. Alexander, Grayling, Mich.; Professor J. E. Reighard, Ann Arbor, Mich.; E. A. Tulian, Leadville, Col.; John G. Ruge,

Apalachicola, Fla.; G. C. Leach, St. Louis, Mo.; H. A. Morgan, Baton Rouge, La.; Professor Henry B. Ward, Lincoln, Neb.; R. S. Oberfelder, Sidney, Neb.; W. W. Barrett, Church's Ferry, N. D.

The President appointed Mr. C. Spencley to act with Mr Dale and Mr. Clark, members of the executive committee, and the names of the candidates were referred to the committee for action.

After consultation the executive committee, through its chairman, Mr. Dale, reported favorably upon the admission of the candidates for admission.

The report of the committee was accepted and adopted, and the applicants declared duly elected.

The President: The next business in order is the reports of officers. I wish to say that I had not supposed it was customary for the President to present any formal report, and therefore have no report to present. We will listen to the report of the Secretary.

The Secretary reported as follows:

To the American Fisheries Society:

Gentlemen: I beg leave to submit the following report for the past year:

Immediately after the close of the last meeting I had two copies of the stenographer's minutes prepared, one of which I retained, the other was separated, the different portions being sent to the members participating in the discussion, for correction, with a printed slip attached urging immediate revision and return. Prompt responses were received, and this action on the part of members greatly facilitated the work of the Secretary, enabling me to put the proceedings into the hands of members at the earliest date by far since I have had an acquaintance with the Society.

Bids were solicited from four responsible firms for the printing of the report, and the lowest bid was accepted, being much below any others received. Not only was the price per thousand ems lower, but the quantity of matter set to the page was greater, the type being considerably smaller than that used in prior reports.

During the year I have sent out to members personal letters requesting their co-operation in securing candidates for mem-

bership. While this did not meet with the general hearty response looked for, something was done, and I wish specially to acknowledge the assistance of the Hon. J. W. Titcomb for the interest taken by him in this effort. He has secured four applications, and I think has others in view. This work was done without any special effort on his part by simply keeping the matter in mind. I have secured seven applications, and would suggest to members the advisability of doing a little of this work in the future, which will result in bringing in persons who, even if they do not attend, are interested in our work and would be quite willing to take membership for the purpose of getting the reports of the Society.

The inducement held out to persons to join used by Mr. Titcomb and myself was that a person putting in his application during the interim between meetings would receive the report of the last meeting gratis, and his application not coming in to be acted upon until the next meeting he was thus practically given the benefit of a two years' membership for one year's fee. I know no better use to be made of the reports on hand, after the distribution has been made to members.

Following out the suggestion of the society at the last meeting, in May of this year I prepared and sent out a circular to the membership, and to others likely to be interested in our work, inviting their attention to the Omaha meeting, and asking them to contribute papers on some subject of interest to the Society. The result was very encouraging, as is evidenced by the excellent program of papers prepared for this meeting, which is in your hands. I think the preparation of a program in advance is a good idea and has fulfilled the expectations of those who suggested it, and in my opinion should be followed out every year.

Following the issuing of the program, 175 postal cards with return reply attached were sent out to members asking them to notify me whether they would attend the meeting, so some arrangement could be made for their comfort in the way of transportation, not otherwise to be secured.

The work of this office in the way of correspondence has been quite voluminous, something like three hundred personal letters having been received and answered. This, in connection with the preparation of the report and the issuing of circulars and program, has called for the expenditure of considerable time, but if it shall result in added interest in our work and a successful meeting it has been worth what it cost in expenditure of time.

On the recommendation of my predecessor in office, the Society directed an official seal be procured, which I did. I can see no use to which the seal may be put, but I have carried out the direction of the Society in this regard.

In making up the report last year I found that the nominating committee, in its report, which was unanimously adopted, had made a mistake in putting on the executive committee a gentleman who was not a member of the Society. This fact was overlooked at the time of the adoption of the report. While the gentleman named would have been a most desirable member of that committee, considering the fact above stated, I took the liberty of substituting in his stead the name of Mr. H. A. Sherwin, who was present at the meeting, and who takes an active interest in our success.

After issuing the report of the last meeting my attention was called to the omission from the list of active members of the name of Mr. Carl Thompson. This was a mistake, the gentleman having paid his dues and being in good standing as a member. His name was included in the report sent by me to the Treasurer as among those who had paid dues. How the error occurred is unexplainable, but it is one of those annoying mistakes which will occur. His name should be placed in the next list published. A letter was written Mr. Thompson apologizing for the mistake.

Following out the action taken at the last meeting, copies of proceedings were only sent to those entitled to them on account of membership. Complaint as to this has arisen only in one instance to my knowledge. Mr. C. B. Reynolds, the proprietor of Forest and Stream withdrew from membership in the Society at the last meeting. Soon after the distribution of the report Forest and Stream contained an article commenting on the action of the Society in confining the distribution of its reports to members. The article seemed to me to require a reply, and the following was sent to that paper and was printed:

Detroit, Mich., Oct. 11, 1897.

Editor Forest and Stream:

My attention has been called to an item on the first page of your issue of October 9th stating that you had failed to receive a report of the American Fisheries Society, and commenting on the action of the Society in restricting the distribution of its reports to its members. While the Society did so restrict the distribution, I knew it was not its intention to exclude the sporting

press, and, therefore, immediately on its issue I mailed to Forest and Stream and other kindred publications a copy. If your copy was not received it must have been through some fault of the mails. I know the copies mailed to some of the other papers were received and I presumed you had received yours. There was no intention of denying Forest and Stream a copy. I wish you would give this letter publication in order that neither the Society nor myself may be misunderstood in this matter.

HERSCHEL WHITAKER.

Mr. Fred. Mather also wrote an article on this subject to that paper, which was published before the one written by me, given above. Mr. Mather took the ground, which is the true one, and which appealed to him after a long connection with this Society as its Secretary, that the possession of the reports should be one of the strongest inducements for persons interested in our work to join is they wished to enjoy its benefits and privileges.

The report of the Secretary was accepted and ordered printed.

The report of the Treasurer was then submitted, as follows:

New Rochelle, N. Y., July 12, 1898.

To the American Fisheries Society:

Gentlemen: I herewith submit my report as Treasurer from June 15, 1897, to July 10, 1898:

By my report rendered June 15, 1897, the balance in hands of Treasurer was		$327 77
Dues since collected amount to $348, as follows:		
1894 dues	$6 00	
1895 dues	6 00	
1896 dues	6 00	
1897 dues	330 00	
		348 00
		$675 77
Disbursements		274 51
Leaving a balance in hands of Treasurer at this date of		$401 26.

The membership is about the same as at last report, eleven new members being elected at the last meeting in June, 1897. Lost by death, 1, Mr. David G. Hackney, of Ft. Plain, N. Y. By resignation, 4, Dr. T. H. Bean, Frank Foggin, R. M. Mackay

and H. H. Lyman. By request to have their names dropped from list of membership, 3, Edward Thompson, J. E. Ashe, C. E. Griffith. One who claims he is not a member, A. A. Hyman. Not to be found, S. H. Palmer. Dropped for non-payment of initiation fee, Dr. A. W. Hoyt. For non-payment of dues under constitutional provision, 4. C. F. Chaberlayne, elected in 1894 and paid '94 dues only. G. W. Upton, elected in 1893 and paid 1893 dues only. W. R. Huntington, elected in 1893, paid 1893 dues only. J. F. Offensend, elected in 1892, paid only 1892 and 1893 dues, and one who requests his name to be dropped for non-payment of dues, Mr. C. W. Smiley, elected in 1894 and paid only 1894 and 1895 dues. Total dropped and resigned, 16.

There remains a trifle larger amount of dues uncollected than at the close of last year, although bills with special requests were sent to all members in arrears on August 20th, October 20th and December 20th, 1897, and on March 20th and June 10th, 1898. The request sent December 20th contained a return stamped envelope.

I submit this as supplementary to my regular report, as general information for those present at the twenty-seventh annual meeting.

Yours truly,

L. D. HUNTINGTON, Treasurer.

American Fisheries Society in account with L. D. Huntington, Treasurer:

RECEIPTS.

June, 1897, balance in hands of Treasurer	$327 77	
Received at hands of H. Whitaker, Secretary, dues collected at meeting held at Detroit, June, 1897, 1894 dues $6, 1895 dues, $6, 1896 dues $3, 1897 dues $69	84 00	
Dues received by Treasurer direct from members, 1894 dues 0, 1895 dues 0, 1896 dues $3, 1897 dues $261	264 00	
		$675 77

DISBURSEMENTS.

June, 1897, account of Treasurer direct, typewriting 65c, express 25c	90
August 20, 1897, account of Treasurer direct, postage stamps	4 12
September, 1897, account of Treasurer direct, printing and stationery	3 25

October, 20, 1897, account of Treasurer direct, postage stamps	2 34	
December 20, 1897, account of Treasurer direct, typewriting 75 letters	2 50	
December 20, 1897, account of Treasurer direct, postage stamps	3 40	
January, 1898, account of Treasurer direct, printing and stationery	1 50	
January, 1898, account of Treasurer direct, postage on reports	56	
March, 1898, account of Treasurer direct, printing stationery	1 50	
March, 1898, account of Treasurer direct, postage stamps	1 40	
June 10, account of Treasurer direct, postage stamps	86	
July 10, account of Treasurer direct, postage stamps	30	
August 23, 1897, account of Treasurer direct, Speaker Printing Co., printing proceedings	113 95	
October, 1897, account of Treasurer direct, L. B. Case, stenographer at Detroit meeting	81 80	
April, 1898, account A. N. Cheney, 1896, Secretary, $3.70, $5.20	8 90	
Account H. Whitaker, Secretary, as per his account, postage	18 95	
Account H. Whitaker, Secretary, as per his account, expressage	8 68	
Account H. Whitaker, Secretary, as per his account, printing and stationery	15 10	
Account H. Whitaker, Secretary, as per his account, official seal	4 50	
		274 51

Balance in hands of Treasurer, July 10, 1898.....$401 26

L. D. HUNTINGTON, Treasurer.

New Rochelle, July 12, 1898.

A recess was then taken to afternoon.

AFTERNOON SESSION.

Mr. Peabody in the chair.

Secretary Whitaker: There are two items of business here

that I think had better be attended to before we proceed with the regular program.

I have invitations from different parties in regard to the meeting of the Society for next year.

Secretary Whitaker then read a letter from David S. Rose, Mayor of Milwaukee, and also a telegram sent by the Citizens' Business League of Milwaukee to the President of this Society; also a letter from John W. Titcomb, President of the Vermont Fish Commission; also a letter from A. S. Hastings, Mayor of Niagara Falls, N. Y.; also a letter from the President of the State Park of Niagara Falls, inviting the Society to meet at that place.

I think it would be well to appoint a committee to select the place of meeting for next year, and I move that the chair appoint a committee of three to decide upon the next place of meeting.

The motion was duly seconded and unanimously carried.

The Chair: I will name that committee later on.

Secretary Whitaker: I move that the invitations read be received placed on file and referred to the committee.

The motion was duly seconded and carried.

President W. L. May then resumed the chair.

Secretary Whitaker: I have a communication here from Mr. Emilie Cacheux. I have had a translation made, which is as follows:

The Second International Congress of Commercial Fisheries and Oysterculture, under the auspices of the Ministers of Commerce, of Public Instruction, of the Colonies and of the Marine and Agriculture, in conjunction with the Chamber of Commerce of the City of Dieppe, from the 2d to the 6th of September, 1898.

Office of the General Secretary,
25 Quai St. Michel, July 6th, 1898.

To the Secretary of the American Fisheries Society:

I have the honor of addressing you by this mail a pamphlet of our society and a program of the International Congress of Fisheries, which meets at Dieppe from the 2d to the 6th of September next.

We shall be very happy to see your society represented at this Congress, whose prime object will be to effect a preparation

for the meeting to be held at Paris in 1900 of the Exposition Universelle.

You are undoubtedly aware that there will be held an International Congress of Fisheries at Bergen, Norway, July 18th to 21st. To avoid a conflict of the several International Congresses it will be necessary to form a permanent committee having charge of the arrangements for this meeting, and we count upon that being done at Dieppe. Can you not bring this matter up at the meeting at Omaha, and ask the several societies that will be there represented to designate some persons to represent them upon this permanent committee for the International Congress? We shall complete the committee at the Dieppe Congress, and will exchange ideas through our respective bulletins.

Accept, my dear sir, the assurances of my highest consideration.

EMILIE CACHEUX.

Mr. Peabody: I move that Professor Birge be appointed to represent the Society in response to the invitation just read, and attend if he can.

Professor Birge: I suggest that the matter be referred to the executive committee that will be appointed at this meeting. Let them correspond and see if they cannot find some of the Eastern men who are interested in the Society and who will consent to represent the Society.

Mr. Clark: A member of this Society, Captain Collins, is probably in Bergen now.

Mr. Whitaker: Captain Collins is not a member. I suggest that the matter be held in abeyance until some future time at this session.

The Chair: Very well, if there is no objection it will be so ordered.

The President announced the following committee on place of next meeting: Mr. Herschel Whitaker, of Michigan; Mr. Calvin Spencley, of Wisconsin, and Mr. J. A. Dale, of Pennsylvania.

President: Is the Auditing Committee ready to report?

Mr. Spencley:, chairman of the Auditing Committee, submitted the following:

To the American Fisheries Society:

Your committee, appointed to audit the report of the Treasurer of the society, beg leave to report:

That they have carefully examined the same and the accompanying vouchers and found the same correct in all respects and they find that the balance in the hands of the Treasurer at the date of said report was the sum of $401.26.

They further recommend that the society tender to the Treasurer a vote of thanks for the great zeal he has used in collecting the dues from the members of the society, which has resulted in the present very satisfactory state of your society's finances.

CALVERT SPENCLEY,
JAS. A. DALE,
J. E. GUNCKEL.

President May: What is your pleasure as to the report of that committee?

Mr. Clark: I move you that the report of the committee be accepted and adopted.

The motion was seconded and unanimously carried.

Mr. Dale: I beg leave to submit the following majority report of the committee on the reduction of dues:

A discussion before the Auditing Committee in regard to the reduction of the dues of the society was participated in by a large number of the members. The majority of the Auditing Committee beg leave to report that they believe a reduction at this date of the dues to $2.00 a year would be sufficient to sustain the financial work of the society and add greatly to its membership.

The committee would also suggest that a certificate of membership in the association be procured.

JAS. A. DALE,
J. E. GUNCKEL.

Mr. Spencley submitted the following minority report:

To the American Fisheries Society:

As a member of your committee, to whom was referred the question of the advisability of reducing the dues for membership and the amount of annual dues, I beg leave to make a minority report.

I am satisfied, after a careful consideration of all that was said before the committee on the subject, that it would be for the interests of the society to reduce such membership fee and annual dues to the sum of $1.00.

I believe that this would very greatly add to the membership of the society and the attendance at its meetings and that its in-

fluence and importance would be thereby greatly increased. I am satisfied that the addition to our membership would be so great that the annual dues of $1.00 would be ample to provide for all the expenses of the society, and would, in fact, produce a greater revenue than the present dues of $3.00 or even of the $2.00 fee recommended by the majority of the committee.

All of which is respectfully submitted.

CALVERT SPENCLEY.

Mr. Spencley: I beg leave to move its adoption.

Mr. Peabody: I will second the motion.

Prof. Birge: I move that both reports be laid on the table and be made a special order for the meeting of 1899.

Mr. Spencley: I hope that motion will not be pressed by Prof. Birge. I think that is a matter that should be considered now. If Prof. Birge's motion prevails it will simply cut off all debate.

Prof. Birge: I will withdraw the motion if you desire to discuss it.

Mr. Nevin then seconded the motion to adopt the minority report.

Mr. Stranahan: What are we to understand as to the powers we have; have we the power to change these fees or dues with our present membership?

Secretary Whitaker then read the constitution as to the point in question.

President May: Under the constitution we have the right to change the amount of dues, and fifteen members being present two-thirds will be sufficient to make the change.

Mr. Clark: What is the question before us?

President May: The question before the house is on the adoption of the minority report.

Mr. Clark: I move as an amendment that the minority report be laid upon the table and that a committee of five members be appointed to report upon this matter at our meeting in 1899.

Mr. Whitaker: I second Mr. Clark's amendment.

President May: The amendment is in order. The amendment is to lay on the table; that does not admit of debate.

The motion was put by President May and as the vote seemed to be in doubt, a division of the house was called for. A rising vote was taken, resulting in the amendment being lost.

The President: The question now occurs on the original motion, which is on the adoption of the minority report.

Mr. Spencley then discussed the minority report, advocating its adoption.

Mr. Whitaker opposed the adoption of the minority report.

Mr. Clark: I wish to be on record in this matter in the report. I desire to say that I am opposed to the reduction of the dues at this time and the motion that I made to lay this minority report upon the table and appointing a committee would probably accomplish the same thing. I want to say that I want to have other members have some voice. I want to be put on record as opposing the reduction of the dues.

President May: Are there any further remarks? If not, we will call the roll on the adoption of the minority report.

A roll call was had, resulting in fifteen votes being cast; ten voting in the affirmative and five in the negative.

Two-thirds having voted affirmatively, the minority report was declared adopted and the dues were reduced to $1.00 per year.

Mr. Peabody: I understand this refers to next year.

Mr. Spencley: That is a proper question to settle, whether it should apply to the present year or the future. It is not mentioned in the report.

Mr. Peabody: I would move that this do not apply to the dues for the past year, but to membership dues for the coming year.

Mr. Clark: It occurs to me, now that we have voted on this, that I am very much inclined to think that it should apply at once. I move to amend, that this resolution just passed shall apply to all members who shall join this association to-day or during this meeting and to all dues that are due to-day.

The motion was duly seconded and carried.

Mr. Whitaker: I move you, in order to keep the finances of the society straight, that the Secretary be directed to return to the persons whose applications with full fee are in to-day, the difference between the one dollar and three dollar fee for dues.

The motion was duly seconded and unanimously carried, and it was so ordered.

Mr. Dale: I move you that the chair appoint a committee of ten members on the increase of the society, and that the gentlemen who moved the adoption of this report to reduce the fee to one dollar, be the members of that committee.

The motion was seconded.

President May: It has been moved and seconded that a committee of ten to secure new memberships be appointed by the chair.

Mr. Spensley: I move to amend; that all members of the society be appointed on that committee to endeavor to get new members.

The amendment was duly seconded and unanimously carried.

Mr. Gunckel: If it is the proper time to make a motion that a committee be appointed to select officers for the coming year, I would make a motion that the chair appoint a committee of five members for that purpose.

The motion was duly seconded and carried.

President May: I will announce that committee later.

Secretary Whitaker: The first paper in order on the program, is a paper by Mr. James Nevin, Superintendent of the Wisconsin Fish Commission.

Mr. Nevin read the following paper:

ARTIFICIAL PROPAGATION VERSUS A CLOSE SEASON FOR THE GREAT LAKES.

Inasmuch as some of the states have passed laws making a close season for fishing on the Great Lakes during the spawning season of certain kinds of fish, expecting thereby to accomplish greater results in increasing the supply of fish thus protected than is derived from artificial propagation, I am impelled to devote my paper, for the most part, to an expression of my views of the relative value of the two methods of increasing the supply of valuable food fishes in those lakes. It is true that both methods may be employed in the Great Lakes at the same time, and perhaps with good results; but if both are employed at the same time in the same waters, if the desired increase of fish be forthcoming, the question will then arise as to which method we are to attribute

the results; and in consequence it may end in the abandonment of one method for the other, and possibly in the uncertainty of the case, the abandonment of the method which has done the most to bring to us the desired increase of fish. For this reason, it seems apropos at this time, that a discussion and investigation of both methods be made here and now relative to the results which have been obtained from both methods as employed in the past at different points, together with a presentation of the arguments for and against both methods. We have considerable knowledge of both methods and know something of the apparent results from each. We have the experience of practical men and the conclusions they have drawn, pro and con, which we may discuss here at this time; and thus place on the records of the American Fisheries Society our views and our knowledge of these matters; which may be of benefit or at least of interest to those who take up the work of fish culture after it has passed from our hands and "Old Time" has applied his scythe to the line which binds us to our vocation.

Personally I have been on the various spawning grounds of the whole chain of Great Lakes from the Gulf of St. Lawrence to Lake Superior during the spawning seasons; and I have many times watched the salmon trout, whitefish and wall-eyed pike spawn in their natural way; and I am convinced that only a very small percentage of the eggs so deposited are fertilized. If as large a number of eggs as is claimed by some people are fertilized in the natural process, I inquire, what becomes of the fish after they are hatched? When we come to take into consideration the number of eggs that each female whitefish, lake trout and wall-eyed pike will produce, we may well make this inquiry. A four-pound whitefish will produce 50,000 eggs; a six-pound lake trout, 8,000, and a five-pound wall-eyed pike about 100,000. These figures, considered in connection with the vast number of fish of various kinds in the lakes, require no backing with argument to justify the question, "What becomes of the fish after they are hatched?"

Some years ago I had an interesting and profitable experience watching whitefish spawn in ponds on the Detroit river. The female fish would come to the top of the water and throw her eggs whether there was a male fish in her vicinity or not. To me it seems impossible that the male fish can fertilize one egg in a million that are thrown off by the female, when I know that it is absolutely necessary that the milt come in contact with the eggs immediately after they are thrown off by the female and while

the micropyle is open to receive it; and considering the small amount of milt possessed by the male and the manner in which it is thrown off into a large body of water.

Another circumstance that confirms me in my belief as to the small number of eggs fertilized by the natural process is the order in which the male and female fish come on to their spawning beds. In the Great Lakes, the first run of fish in spawning time is composed almost exclusively of male fish. They are followed in a few days by the females; and in taking spawn from this second run of fish, we find that seven-tenths of the fish taken are females; and it is a difficult matter to get enough male fish to fertilize the eggs taken. It frequently occurs that pails full of eggs are thrown overboard because enough male fish cannot be procured to impregnate them. A few days after the run of females has passed off, a run of small male fish comes on. I have heard many people say that this run of male fish will fecundate the eggs of the earlier run of females. But those of us who have had experience in practical work know that the eggs cannot be fertilized after they have left the fish two hours. However, assuming that a part of the eggs become fertilized, they must of necessity be lodged among those which are not fertilized and consequently, the fungus growth, with which all fish culturists are familiar, spreads over the entire mass, and the percentage that hatches must be very small. The only way that suggests itself to me that will ever enable us to form an accurate idea or obtain positive knowledge of the number of whitefish eggs impregnated naturally is to have a diver go down on the reefs and bars just after the fish get done spawning, and gather up a few gallons of eggs, which may be placed in a hatchery and the results noted.

Last fall I spent three half-days on a trout stream and examined numerous spawning beds at the time the trout were spawning in the stream. I had such apparatus as I thought necessary to obtain any eggs that might be on the beds, but we did not find a single egg in any nest that we examined. I presume the eggs had been devoured by the trout as fast as deposited. My purpose was to find the percentage of trout eggs impregnated by the natural process. I shall follow up this work again this fall and hope for better results.

There are very few good trout streams in which less than one thousand trout spawn naturally each year. These trout should average at least two hundred eggs each, making two hundred thousand eggs deposited in the stream each year. If five thousand trout are hatched and come to maturity, this should

certainly be enough to keep the stream well stocked, under the protection of a close season eight months in the year. But our experience teaches us that it does not matter how well a stream is stocked, if it is fished for two or three seasons, fry must be supplied from the hatcheries if it is to continue to produce good fishing.

I have done some figuring on my own account to get at the number of whitefish eggs, deposited naturally, required to produce one mature fish weighing two and one-half pounds. I have taken the whole number of pounds whitefish caught on the chain of Great Lakes, that is, Lakes Superior, Huron, Michigan, St. Clair, Georgian Bay and Lake Erie (not including fish taken from Lake Erie in Pennsylvania and Ohio waters), which in 1896 was 8,223,900 pounds. Estimating that each fish taken weighed two and one-half pounds, we find that 3,289,560 whitefish were caught. Estimating that there were left in the water three times as many fish as were taken out and that six-thirteenths of the fish are females (I believe that most practical fishermen will agree that these estimates are low), we find that there were 4,554,747 female fish producing eggs. Allowing an average of 30,000 eggs for each female, we find that 136,642,220,000 eggs were deposited naturally and produced only 3,289,560 mature fish. Thus we find that of 41,568 eggs deposited naturally, only one fish comes to maturity. Of course, many things must be taken into consideration in making these estimates; and at best the estimates as well as the results obtained are barely approximate. Yet it gives us something of an idea of the vast number of eggs that must be deposited in the natural process to produce a single mature fish. In making these figures no account is made of the millions of whitefish fry annually planted by the several states and the United States.

Thus after spending twenty-five years in the work of fish culture and propagation, I cannot but conclude that an enormous loss of fish of nearly all species occurs in the egg stage, because the eggs deposited by the female are not fertilized. The result is, our streams and lakes become depleted of fish within a short time after men with modern fishing apparatus begin to take fish from the waters for food. Nature's provisions for the survival and increase of the several species of fish are not adequate. To rectify this apparent error in nature's laws, we have resorted to artificial propagation with gratifying results. That we still have much to learn in this work, we all agree. But at the same time, I believe that all fish culturists and those whose knowledge of the

subject qualifies them to speak intelligently of it, will admit the complete success of artificial propagation with many species of fish. I refer particularly to the stocking of our Wisconsin streams, once barren, with brook and rainbow trout; and the planting of shad in the rivers of the Atlantic and Pacific coasts, facts with which we are all familiar. A few years ago shad were unknown on the Pacific coast. A few thousand fry were taken from New York State and planted there. To-day shad are as plentiful on the Pacific coast as on the Atlantic. The planting of salmon fry in the rivers of the Pacific coast has done wonders in the way of increasing the salmon. Many other species have been made to increase and multiply very rapidly.

That whitefish eggs can be hatched artificially in large numbers, there is no question; and I hold that given suitable planting grounds on which the proper food is found in sufficient quantities, and protection to the small partly-grown whitefish until they come to maturity, there is no reason why we should not have the same success in maintaining the supply of these fish as we have had with others.

Our experience with the inland lake whitefish in Wisconsin has demonstrated this to our satisfaction. In 1889 and 1890, a large number of inland lake whitefish fry was planted in Chequamegon Bay. The eggs from which these fish were hatched were taken from Lake Mendota, at Madison. In about three years after the fry was planted, the fish began to show up to good advantage and are now taken by tons in Lake Superior. This seems to us good evidence of what can be done by artificial propagation, where the waters into which the fish are introduced are naturally adapted to them.

Relative to the operation of laws providing for a close season on the Great Lakes, I call attention to the Province of Ontario, Dominion of Canada. The Province of Ontario has had a close season for the fish of the Great Lakes for the past twenty-five years. The fish protective laws are much more rigidly enforced on the Canadian side of the Great Lakes than on our side. The fishermen operate under a license system. The number of boats and nets that may be used is limited. The number of pound nets which may be set in a string, the number of strings in a locality, the size of the mesh, and the manner in which they may be set in channels, etc., are all carefully prescribed. Each fisherman is limited to certain specified grounds, and he is not permitted to fish on any other grounds than those allotted him; nor are other fishermen permitted to fish on the territory assigned to him.

This feature of the law operates very decidedly to protect the fish in many instances where the fish run in large numbers to certain localities at certain times of the season or year. In such instances, the fisherman having the right to fish in the locality where the run is large, can only fish the number of nets allowed him in his license, and his neighbors are not permitted to set their nets on his grounds; and many fish which would be taken if a larger number of nets were set, escape. To illustrate this point, I have seen as many as eight tugs fishing on one small reef, and occupying so small a territory that the nets of the different tugs were crossed and recrossed several times.

Recently I have gone through the several annual reports of the Fisheries Department of the Dominion of Canada to find the results of their close season for twenty-five years on the catch of whitefish for the Province of Ontario from Lakes Superior, Huron, Erie, St. Claire, Georgian Bay and the Detroit River. I have compared the catch of whitefish in the Province of Ontario with the catch from the same waters in the State of Michigan, which has less coast line than Ontario and has not had a close season until this year.

From the last Biennial Report of the Commissioners of Fisheries of the State of Michigan, I learn that from the year 1891 to 1895 there was a decrease of 58 6-10% in the catch of whitefish in that State. In the Province of Ontario, I find that during the same period there was a decrease of 58 5-10% in the catch of whitefish. This is approximately the same rate of decrease as in Michigan, notwithstanding the fact that the number of nets used in Ontario increased, during this period, 32 3-5% as against an increase of only 9 1-5% in Michigan. In this connection, it should also be remembered that Michigan has never afforded anything like adequate protection to the small whitefish, while the more rigorous Canadian laws have given very efficient protection to these small fish. When I consider the large quantities of small immature whitefish that have been taken with pound nets during the last twenty years, I often wonder that there are any whitefish left in the waters. In the Michigan waters under consideration, I find that 1,588 pound nets were in use in 1895; no restrictions being placed on the number of nets in a string, or the number of strings in a locality. During the same year in the same waters in Ontario, there were only 342 pound nets in use, and they were restricted as I have indicated above.

Tons of small whitefish are caught yearly from Michigan waters with pound nets; and a large part of them are sold for

herring and listed in the Michigan fish statistics as herring. To bear me out on these points, I quote from the report of Mr. C. H. Moore, statistical agent of the Michigan Fish Commission, who furnishes numerous letters from fishermen and other data to substantiate his statements. Mr. Moore says: "Of the 1,717,220 pounds of whitefish caught in this district (No. 5) in 1895, 470,000 pounds (27%) were immature fish and every ground in this district fished with pound nets furnished a portion of this amount of small whitefish in greater or less quantities, but more notably so at Marquette and Detour, where liberal plants of whitefish have been made during the past five years. In this district as well as in the others, the use of the pound net is the chief device in the destruction of the young whitefish."

"At all the above stations small whitefish are taken, and the fishermen in reporting their annual catches, put them under the guise of herring.

"The catch of immature fish and the wasteful manner of fishing practiced by the fishermen throughout Michigan's entire coast, especially where pound nets are fished, is a matter of great concern, and is doing more than any one thing to deplete the Great Lakes of whitefish and must ultimately ruin the fisheries of the State." In contradistinction to this state of affairs in Michigan waters, I find but one or two instances in the reports of the fishery overseers of the Canadian fisheries where mention is made of immature whitefish being taken in Ontario waters, in which, as I have shown, only a limited number of pound nets are used.

If the young whitefish caught in Michigan waters and listed in Michigan statistics as herring were properly listed in those statistics, Michigan's apparent annual catch of whitefish would be considerably increased.

It is evident, then, that the whitefish caught in Canadian waters are, by virtue of good laws, well enforced, larger and average a greater weight per fish than those caught in Michigan waters; and it follows that for the same number of pounds of whitefish in the aggregate, Michigan waters produce many more whitefish than are produced in the same waters in Ontario. It should be noted here, too, that Michigan's annual catch of whitefish from the waters under consideration is larger in the aggregate of pounds than the catch from Ontario waters, although Michigan has less coast line on those waters than Ontario.

Thus, on the whole, we get a showing very favorable to Michigan waters with fishing the year round as against Ontario with a close season of twenty-five years' standing. I firmly believe that

this favorable showing for the Michigan waters is due to the fact that the Canadian Government has not planted as many whitefish fry in the waters which we have been considering as the Michigan Fish Commission has planted.

What has been said of depleting our waters of whitefish by catching the young immature fish, is also true of lake trout, though the manner of taking the small lake trout is different. During the last few years the fishermen have found it profitable to reduce the size of the mesh of the gill nets used in catching chubs, blue-fin, and herring. With these small meshed nets, they are catching large quantities of small, undersized lake trout. This should not be permitted to continue if we are to keep the lake trout in our waters and on the market as a commercial fish for future generations.

The conditions existing in Michigan waters in relation to a close season, the planting of whitefish fry, and the taking of small whitefish and lake trout, as herein set forth, apply with equal force to Wisconsin waters.

Last year I had the pleasure of taking a trip up Lake Winnipeg and looking over the fishing industry, picking up what information I could relative to fish and fishing on that lake.

Taking into consideration the laws in force relative to catching whitefish, to an onlooker, it would seem that the whitefish could never be exterminated from Lake Winnipeg. No pound nets are permitted in the lake, and no gill nets of less than five and one-half inches mesh. Fishing with nets is not allowed within ten miles of the mouth of any river. All nets are taken out of the water on Saturday and are not reset until the following Monday. No small fish are caught. The whitefish caught will average four pounds each. The government permits but a certain number of fathoms of nets in the lake at one time, and these must be set on certain grounds.

With these restrictions on fishing, it would seem that this lake should be productive of whitefish for all time to come. However, such does not appear to be the case. In talking with the foreman of one of the fish companies at Selkirk, I asked him if whitefish are as numerous now as when he first went there, which was some twelve years ago. He replied: "When I first came up here, we would go out in the lake with a tug, and I would hold up my fingers to the Indians to indicate the number of fish that I wanted. Every finger that I held up would mean one hundred fish, and they were off with their canoes and dip-nets and would get us all the fish we could carry on the tug.

To-day, our tugs go up on the fishing grounds, some two or three hundred miles, to get their supply of fish."

The decrease in the number of fish caught in certain parts of the lake became so perceptible that in 1890 the government appointed a commission to go to Lake Winnipeg and investigate, to find the cause, if possible. At this time the use of nets having five-inch mesh was permitted, but the fishermen preferred to use nets of five and one-half inches mesh. It cannot, therefore, be said that they were catching large quantities of small whitefish with small meshed nets. This decline in the catch of whitefish was and is taking place under a close season which has been in force several years.

Boys who began chasing whitefish on Lake Ontario, then on Lake Erie, Huron, Michigan and Superior, you will find to-day as aged, white-haired men, still chasing whitefish on Lake Winnipeg.

If the government does not soon begin to plant large numbers of whitefish fry in this lake, in another decade the whitefish of Lake Winnipeg will be a thing of the past, in spite of the close season and the stringent laws which they enforce for their protection.

I consider the close season for fishing on the Great Lakes as being in the interest of the syndicate of fish dealers, who, while the fishing is closed for thirty days, are given an opportunity to dispose of their frozen fish which they have stored in their freezers in the northwest, to the disadvantage of the small fishermen on the lakes.

I believe that if it were not for the liberal planting of whitefish fry in the Great Lakes, the whitefish would have been practically exterminated years since. What we need is protection for the small fish; and artificial propagation will keep the lakes and streams well supplied with desirable food fish.

Secretary Whitaker: So as to correct the record, I desire to say that Mr. Nevin has made an error in his figures, so far as Michigan is concerned, as to the decrease or dropping off of whitefish. In 1885 the statistics were taken by a man who was very thorough in what he did, but he didn't begin to cover the territory that has since been covered by the man now in charge; the figures of 1885 didn't show the total catch of that year. The catch of whitefish in 1885, as shown, was something over 8,000,000 pounds; the last report shows something like 3,000,000 and some pounds. It has been going down rapidly. Mr. Nevin has made a mistake in his figures.

Prof. Birge: Your year would be 1885; Mr. Nevin's report is as to 1893.

Mr. Whitaker: Of course all the value there is in statistics is to show the exact facts. If you will take 1885 and other years that we have reports of clear down to 1895, you will see that the figures show a decrease of whitefish each year reported down to 1895, when it was 3,353,187 pounds, showing a very much larger per cent. of decrease than would be indicated by your figures. You don't take your figures far enough down to show the effect of it. I fancy Michigan has been the largest planter of whitefish in this country, yet we find an enormous decrease in the catch. It is necessary that something be done to arrest this. Statistics are valuable so far as they go, but you cannot draw from the facts what Mr. Nevin seeks to show, that the loss or decrease is not so great in Michigan as in Canada waters and that planting under present conditions has sustained the catch in our waters.

Mr. Spencley: Wouldn't the same conditions exist in 1885?

Mr. Whitaker: Yes, but what I say is, that the statistics did not cover the waters as completely in 1885 as they have since 1891. I believe in hatching whitefish; Michigan has done as much as she could, and she has had the assistance of the United States in that work, yet notwithstanding the immense numbers of whitefish planted, the falling off in catch has been enormous.

Mr. Clark: I have a short paper and after hearing Mr. Nevin's paper, I want to say that my paper treats upon this same subject; that is, in a general way. Before any general discussion is had, I think it would save time to present it, and perhaps others. Wouldn't it be better to present the papers pertaining to this subject and then take up the discussion? I would like to present my paper now and then have the discussions.

Prof. Birge: I move that the papers that deal with the subject of fish propagation be taken up now.

President May: I want to announce the committee on the nomination of officers. The committee will be Mr. Gunckel, of Ohio; Mr. Dale, of Pennsylvania; Mr. Whitaker, of Michigan; Mr. Spencley, of Wisconsin, and Mr. Clark, of the United States Fish Commission.

Mr. Dale, chairman of the Executive Committee, presented the following names for membership and reported a recommendation that they be accepted, and moved the adoption of the report.

The names presented are as follows: D. Lydell, Mill Creek, Mich.; H. H. Marks, Paris, Mich.; J. P. Marks, Paris, Mich.; A. C. Babbitt, Sault Ste. Marie, Mich.; J. W. Powers, Paris, Mich.; H. B. Stranahan, Cleveland, O.; F. F. Stranahan, Cleveland, O.; F. A. Stranahan, Cleveland, O.; E. M. Ball, Put-in-Bay, O.

The motion carried and the candidates were elected.

Mr. Clark then read a paper on "Notes in Connection with the United States Fish Hatcheries in Michigan," which follows:

NOTES IN CONNECTION WITH THE UNITED STATES FISH HATCHERIES IN MICHIGAN.

At the twenty-sixth annual meeting of this society a paper was presented by Mr. Titcomb, of Vermont, on "Wild Brook Trout Spawn." In connection with that paper there was a discussion with reference to the facts presented in all their aspects, and mention was made by me in this discussion of our work of collecting wild brook trout spawn on the Au Sable river in Michigan, a stream formerly known as one of the greatest grayling streams of the United States, but now stocked with brook and rainbow trout. Thinking that perhaps some notes in connection with this work might be of interest to the members of the society, I will lay them before you.

First, however, let me answer the question asked last year by Mr. Bryant, of Wisconsin, as to the difference between fry from eggs taken from wild trout and the fry from the eggs of domesticated trout, whether there was any difference in their vitality, growth, etc. In this connection I would say that 5,000 fry from the wild trout eggs for the season of 1898, after being fed three months on liver and obtaining the length of 2½ to 3 inches, were placed in a spring at the Northville hatchery, where they were subjected to the same environments that they would be in a natural stream or pond; or in other words, they have received from that time up to the present writing no artificial food and they were placed in the spring the fore part of June. From all observations, which have been made practically daily, these trout are doing remarkably well and not a single dead fry has been found. It is, of course, possible that some of them may have died and become fouled in the moss and weeds of the spring, but from the showing at the present time, there is probably the larger percentage of them alive and healthy.

These trout have now been in the spring about forty-five days

and are assuming a different color from those that are being fed on liver; the tails and fins are becoming highly colored. I think this also partly settles one of the mooted questions in reference to planting partially-reared fish, that fish raised on liver from six to eight months and then planted, would starve to death before they would accustom themselves to their changed environment and to finding their own natural food. So much in answer to the question that I was unable to answer a year ago. Now to our work of collecting wild brook trout for spawning purposes, on the Au Sable river. This was undertaken by the United States Fish Commission in the fall of 1895; men were dispatched to this river late in August and a camp was formed on a branch that had been previously leased by the United States Fish Commission for the purpose of building ponds for temporary use for holding trout. I quote from the report to the United States Fish Commission in reference to these ponds:

"A dam was thrown across the stream and 100 feet above a screen was built to prevent the fish from escaping in that direction. This dam was simply constructed, being built of mud, sand and turf banked up, and had a frame sluiceway 3 feet long, 2 feet wide and 2 feet deep, with the necessary double screen put in the overflow to prevent the passage of fish below, making an inclosure about 100 feet long by an average width of 12 to 15 feet. This inclosure accommodates about 10,000 fish."

The fishing was commenced with rod and line soon after the camp was established, and occasionally with the seine, to collect fish in that manner. The rod fishing was continued until about the 1st of October, when the trout commenced running on the beds, and then the seine was used exclusively.

The first season there were taken from the stream by rod and line and also by the seine, upwards of 6,000 trout; from these in the neighborhood of 400,000 eggs were taken; the first eggs being taken about the 1st of October. These were placed in troughs that had been previously arranged.

As soon as ripe fish are found among those caught on the spawning beds, the pond is hauled with a seine and the fish are looked over twice a week until all the eggs are taken. When the season is fairly opened the spawn may be taken from most of the fish immediately after they are caught, thus obviating the difficulty of transferring them from the point of capture to the pond: in some cases a distance of three or four miles. I quote from my former report in describing the troughs used:

"The water is received through two one-inch orifices in a

bulkhead about nine feet long, situated at the head of these troughs and fed by a roughly-constructed raceway leading from a small spring about six rods distant on the hillside. The water from each of the openings feeds two troughs so placed that the lower end of the upper one rests upon the head of the other, thus creating a fall of nearly the height of the troughs. Each trough is 14 feet long, 5 inches deep, and consists of a double row of boxes; each box 17 inches long, 15 inches broad and 2 inches deep, giving a capacity of from 8,000 to 10,000 eggs."

As this was an experimental year for this work, the experiments made were noted, and one very important and essential matter in connection with this work was that conclusions in regard to the experiments were very positively determined.

The eggs, after being eyed, were transferred to the Northville Station. On one of the trips in transferring eggs an experiment was made in connection with moving eggs at different ages; from those freshly taken, to the twenty-second day. From these experiments it was definitely concluded and positively proved that in moving brook-trout eggs at this stage they should be moved not later than the eighth day, inasmuch as those moved between the eighth and eighteenth days were practically a total loss.

From these experiments we came to the conclusion that all eggs taken on the Au Sable River at least, should be moved as soon after taking as possible or held until the eyes plainly show.

In the season of 1897, thinking that fully as many eggs would be obtained without using the rod and line, our men were not placed on the Au Sable until the latter part of September, and the work was begun with the seine about the 25th of that month. From that time until the middle of November there were upwards of 10,000 fish taken, probably all of them with the seine. The eggs were dispatched to Northville within a few days after they were taken from the fish, and in some instances the day they were taken, and in no case were they allowed to be older than eight days.

Our success in obtaining a good percentage of wild brook-trout eggs was not as marked as that reported by Mr Titcomb at the meeting last year; we were not able to obtain over 70 per cent. of good eggs; possibly had they been carried forward to the eyed stage on the Au Sable River they would have done somewhat better. In my opinion, it is not possible to remove wild brook-trout eggs from the Au Sable River and have as high

a hatching percentage as is secured from domesticated fish in ponds. At least, that has been our experience on this river. And yet, the Au Sable River is probably one of the best-adapted streams for a work of this kind in the United States; the only drawback, if any, is the small size of the fish.

From the experience and observation of all practical fish-culturists, it has been concluded that not more than 5 per cent. of brook-trout eggs are hatched in a state of nature. Our observations on the Au Sable River have verified this. It is impossible for a large percentage of eggs to be impregnated in the rapid water of that stream. Impregnation is not only more difficult for this reason, but the rapid action of the water, in addition to that of the fish, often covers many of the eggs with gravel to such an extent that they are smothered; while large quantities of those not thus destroyed are subsequently eaten by the fish. In our work we took from 400,000 to 500,000 eggs. If these had been left in their natural element not more than 25,000, or at most 40,000, would have hatched, whereas by artificial impregnation and culture, at least 70 per cent. were preserved, resulting in from 280,000 to 350,000 fry. Of these, 100,000 were planted back in the Au Sable River and its branches this season. From this it will be seen that it is not only practicable and of great advantage to take the eggs from the wild fish, hatch and plant them again, but that the very stream from which they were taken this season is better stocked, to the extent of about 60,000 or 70,000 fry than it would have been if the eggs had not been removed, and this does not take into consideration the several hundred thousands that have been planted elsewhere. Nature, both in forest and stream, notwithstanding her prodigality, is sufficient for self-maintenance, and under favorable circumstances for gradual development, but as is well known, is not sufficient both for self-maintenance and the supply of man's wants. A stream once stocked and left entirely undisturbed, will not decrease in its number of fish, but will invariably do so if there is an unusual draft upon its resources, either during the entire year or during any number of months of each year. For this reason a partially-closed season is seldom, if ever, sufficient to preserve the desired equilibrium. For this method to be absolutely effectual, the closed season should extend over eleven months of each year, if not the entire twelve. But in my opinion it is not absolutely necessary to close the season during any part of the year; it is only necessary to save and mature the incalculable resources that nature now wastes, and thereby by

human assistance enable nature to accomplish that which would otherwise require centuries. If it is ever practicable to take the eggs from the wild fish, impregnate, hatch, and plant them back, open seasons will then be as necessary for the removal of the fish as closed seasons are now supposed to be for their preservation. Indeed, it might even then be possible to remove all restrictions as to the sale of fish. Then, that which is now the sport of the few would become the occupation of many, and the fish that is now a delicacy would be found in any market and on every table.

But even if the artificial hatching of the eggs of wild fish is not yet practicable, it is probable that the closed season is not only not beneficial but in some cases detrimental even under present circumstances. With some classes of fish, it is better, far better, to leave the season entirely open, restrict the taking of fish at all times to those that are mature, and during the spawning months require the deliverance of all ripe fish to the hands of Government and State employes for the preservation of their spawn and the return of the same either as eggs or fry, back to the stream or lake from which they came. This would remove the fish now in the way of growing stock, preserve the food necessary to the young fry, and prevent the destruction of large quantities of eggs now consumed by the matured fish.

But whichever of these plans may be adopted in the near future it is evident that the results of substituting artificial for natural methods is a paying investment, and that we have not only passed beyond the fear that nature's resources may be exhaunted, but we now know that we can multiply them at will and to any extent that humanity may need, provided the means are at hand to obtain the spawn from the fish.

With reference now more particularly to the Au Sable, I have no hesitancy in giving it as my opinion that for an egg-collecting station it is far ahead of any other stream that has come to my notice. The United States Commission or the Michigan Commission should undertake the problem of establishing one of the largest egg-collecting stations in the United States on this river. Ponds and long raceways should be constructed for holding large numbers of parent fish; these may be held from year to year, and no serious obstacle would arise to prevent so doing, in addition to taking wild fish from year to year.

One of the great drawbacks to most fish-cultural establishments has been a limited quantity of water, the station nearly always outgrowing the water supply. This would never be the

case were a station established on the Au Sable, as the quantity of water is practically unlimited. It is safe to say 1,000,000 parent fish may there be carried in ponds and raceways if desired.

With a large establishment located on the Au Sable, from 10,000,000 to 20,000,000 eggs may be collected, carried forward to the "eye" stage, then shipped to other fish-cultural stations. This matter has been laid before the Commission, and it is hoped the work may be undertaken, if not by the United States, I should recommend the matter to the Michigan Commission.

Mr. Bower then read a paper by F. B. Dickenson as follows:

THE PROTECTION OF FISH AND A CLOSED SEASON.

From boyhood's days I have been deeply interested in the subject of fish and fishing, but until quite recently, almost wholly from the standpoint of an angler. As an angler, I was seldom brought into contact with fish life during the season of natural reproduction, for I was led to believe that all fish should be let severely alone at breeding time. Quite naturally, therefore, I had little or no opportunity to observe nature's ways and methods of reproduction, nor to compare the results thus obtained with results under the shielding hand and fostering care of man.

But time's changes led me to accept the office of Commissioner of Fisheries for the State of Michigan; a State that not only has within its borders innumerable lakes and streams of unrivalled character, but is itself bordered by more miles of fresh water than any other state or country on earth, except Canada. I soon realized that I had accepted a position of no little responsibility, for, in addition to the thousands of square miles of inland waters that needed attention, important commercial interests must be controlled and conserved by wise legislation.

For a number of years the question of prohibiting fishing on the great lakes during the month of November had been agitated in our legislative halls, the object of which was to allow all of the whitefish and lake-trout to spawn naturally. Without investigating for myself, and accepting it as a matter of course that such a measure of prohibition would be wise, I worked earnestly and zealously for the enactment of the present closed season law.

During the controversy that finally resulted in the passage of this law, many points were developed that set me to thinking and investigating, and I have continued to think and to investigate until I am thoroughly convinced that, under the conditions that prevail, this law was a most unwise and untimely measure.

I soon discovered that men with heavy vested interests whose value depended on a continuance of fishing for a long term of years, and who had experienced the benefits derived from artificial propagation, were in favor of open fishing in November, with its accompanying concomitant, artificial propogation. Through much correspondence and by personal interview, I soon learned that experienced fish-breeders and fish-culturists everywhere were a unit in agreeing that the law was a blow at the only possible means by which the fisheries may be indefinitely sustained. I have not found a single practical fish culturist who favors the law.

Fish must be caught during the spawning season to protect their spawn, and as such protection to the spawn makes more than a "Hundred blades of grass to grow where one grew before," such profitable increase should not be handicapped nor put under the ban, but should be encouraged and taken advantage of to the fullest possible limit. With open fishing during the spawning season and means provided for saving the spawn, to be multiplied in hatching results many hundred fold, we were on the right track to restore and maintain our fisheries.

But the introduction of young fish by the millions should be followed up with other measures. Undoubtedly a large percentage of the young fish from hatcheries are destroyed by natural enemies, as are the young hatched from natural spawning grounds. This of course cannot be helped; but for man to step in and become an ally of nature in the destruction of partially grown fish, is an offense that cannot be too severely condemned and penalized.

So far as reproductive results are concerned, where provision is made to save the ova, it matters not whether spawning fish are caught by commercial fishermen, or whether boards of fish commissioners turn themselves into commercial fishermen by hiring the same men and apparatus, employing the same methods and disposing of the fish at the highest market price.

But there are one or two points in connection with the catching of spawning whitefish and lake trout by commercial fishermen, that should be incorporated into law throughout the Great Lakes. For the most part the fishermen are more than willing to save the spawn for hatching, although the work of stripping the fish and caring for the ova involves some labor and expense. Still, commissioners should be empowered to require that the crew of every boat or vessel fishing on spawning grounds, should include at least one expert spawn taker, and a heavy penalty

should be laid on a failure to save and fertilize the spawn and turn it over to hatchery agents without expense to the State. If new spawning grounds are discovered, they should be reported at once. In case the spawning fish are caught at inaccessible points, where it is not practical to deliver the ova to hatchery agents, it should be fertilized and returned at once to the spawning shoals. I don't think very much of this plan, however, as unquestionably most of the ova thus deposited is destroyed, but the hatching percentage would be somewhat better than in nature, for nearly perfect fertilization would be obtained. Under the circumstances it would be the best that could be done, certainly much better than to allow it to waste absolutely.

There is another point that would be good law for the Great Lakes and perhaps for other waters. While the catching and marketing of commercial fish should for the most part be left to private enterprise, still the control of this form of public property, the title to which in a wild or natural condition, is vested in the States, should not necessarily be relinquished, and the title extinguished or considered as having been passed at the point of private possession. The public should be empowered to say, through its authorized agents, when the title to public property should pass. This law would enable us to control, for the purpose of holding the breeders a few days in suitable enclosures, whereever practical to do so, to allow the ova to ripen and become available for hatching; then, when stripped of the spawn, turn the adults over to those who caught them.

During the past year I have had considerable correspondence with experienced fish-culturists and investigators, on the subject of a closed spawning season and protective legislation. Recently I addressed several of the old employes of our Commission, asking them to submit a free, candid and unbiased opinion as to the merits or otherwise of a closed spawning season for the whitefish and lake trout of the Great Lakes, and I hereby sumbit their letters in reply:

(From Charles H. Moore, Statistical Agent, Michigan Fish Commission.)

Hon. F. B. Dickerson,
State Fish Commissioner,
Detroit, Mich.

Dear Sir:—It is very gratifying to me that the question of artificial propogation and a closed season are being taken up and

the benefit derived from the former to our commercial fisheries, placed where it belongs.

The experience and opinions of men who have fished the waters of our Great Lakes for the past forty years should be of some value, especially so from a practical standpoint. By following this industry year after year, they learn the habits of the various kinds of fish taken from these waters, and know upon what grounds to go to catch them. They become experts in the business. They can tell you where the spawning grounds of the lake trout are and the season of the year the parent fish visit them, also their feeding grounds at other seasons of the year. Of the whitefish they will tell you that they go about the lakes upon their wonted feeding grounds and spawning beds in schools; hence are more easily trailed and more susceptible of capture than are the lake trout.

Those of intelligence and long experience say, too, that the schools of whitefish make about the same tours through the waters each year; therefore they conclude that they are not migratory to any great extent. This theory they sustain in saying that it is a fact that the whitefish are more abundant in portions of the lake where the fry have been more generously distributed.

In the minds of the more intelligent fishermen there is no longer any doubt about the good results of planting. When compared with natural propagation, they will tell you of three very destructive causes that surround the conditions of ova cast in open waters. First, loss by lack of impregnation, which carried on in open water must be very great; second, loss from the horde of spawn eaters that are always found upon the grounds during the spawning season; third, loss from the elements, which means a great deal to the whitefish, as they go upon clean shoal ground to spawn during the rough, stormy season of November. The hatcheries eliminate entirely the last two causes, and practically so the first; therefore the conclusion arrived at is, make the annual output of our hatcheries as large as possible, if the improvement and perpetuation of our fisheries are desired.

The good effect of this work is shown in the improved take of whitefish in '96 and '97 from the Straits of Mackinaw to the Beaver Islands, covering that portion of Lake Michigan where plants of the young fish have been made with more regularity each year than elsewhere. The catch of whitefish upon these grounds for the past three years is as follows :

	No. 1.	No. 2.	No. 3.	Total.
1895	57,250	13,410	40,740	111,400
1896	205,726	31,405	46,753	283,884
1897	366,180	40,820	92,620	499,620

While the increase above shown is essentially true, another feature of the catch is also disclosed, namely: more than one-third of this yearly increased take were immature whitefish, 2's, 3's and under, and has a hundred fold greater effect in their destruction than taking the adult fish from their spawning beds. Could the wasteful catch of the small whitefish be arrested and planting pushed to its fullest extent, I fully believe that the perpetuation and increase of the whitefish in our Great Lakes can be carried to a successful end. On the contrary, if planting is withheld and we rely wholly upon a closed season for their preservation, the schools of whitefish in the waters of our Great Lakes will very soon nearly disappear.

(From H. H. Marks, Overseer of State Fish Car, Michigan Fish Commission.)

Hon. F. B. Dickerson,
Michigan Fish Commission,
Detroit, Mich.

Dear Sir:—In reply to your request for my opinion of the results obtained from planting whitefish, and of a closed season during the spawning time, I will say that the conditions as they are now are all in favor of an open season and artificial propagation.

I base my opinion upon observations for the past ten years, as my position with this Commission as Field Foreman, collecting whitefish and lake trout eggs, has given me the very best opportunity to see the results of planting whitefish by this Commission, and the results obtained by a closed season in Canadian waters. The condition of the fisheries on the Canadian shore of Lake Superior, from Sault Ste. Marie, Ontario, to Pilot Harbor, are a closed season from November 1st to December 1st, a law regulating the size of mesh of both gill and pound nets, a limit to the number of yards of gill nets fished by each tug and sail boat, also a limit upon the number of pound nets fished to a mile of coast, and all of these laws are rigidly enforced. The results to-day are that the fish are diminishing in size and number. These grounds are controlled and fished by one firm, who find it necessary to let the grounds rest after being fished two or three seasons. The results from the closed season and other restrictions are not sufficient to keep the fisheries up so they can be fished profitably.

On the American shore of Lake Superior, for the same distance of coast line, from the Sault to Grand Marais, where the closed season law has never been in force until last year, or the amount of nets limited to tugs or sail boats, nor the number of pound nets limited to the amount of coast line, the grounds are fished by two of the largest firms in the business, besides numerous small ones. These grounds have received large plants of whitefish fry from the Sault Hatchery in the past seven years, and the result is that for three years there has been a large increase in the catch of whitefish on these grounds. Last year I was informed by the fishermen at Whitefish Point that during June and July their catch was larger than it had been for ten years, and there was no doubt that it was from the result of planting, as the fish were different from their usual run of whitefish in Lake Superior. This is easily accounted for and proves conclusively that the whitefish taken from these grounds were planted fish, for the majority of fish planted on these grounds were hatched from eggs taken on the Detroit River, and it is very easy to distinguish a Lake Erie whitefish from those of Lake Superior.

From the results obtained on Lake Superior, where one shore has had a closed season and a number of other restrictions, and the other having the benefit of artificial propagation, but no protection, I have come to the conclusion that the only salvation for the commercial fisheries is the protection of the small fish until they have come to maturity and by artificial propagation. I think I can safely make the statement that Lake Superior has always had a closed season for whitefish, for I know of but a few grounds where whitefish have been taken in November, that were spawning fish. I believe that a majority of the whitefish spawn in the latter part of November and the first part of December, when it is almost an utter impossibility to fish for them.

The argument used by a great many in favor of a closed season is that the fish are not disturbed while spawning. This is true, but as there is only a very small per cent. of the whitefish eggs fertilized naturally, besides having numerous enemies, the chances of ever hatching or coming to maturity are very small. By disturbing the spawning function, however, and running the eggs through a hatchery, 60 to 90 per cent. of the eggs taken are returned to the waters as fry. All of the fish that come to the spawning ground are not taken; many spawn naturally, and as each female produces upwards of 25,000 eggs, if a very small per cent. of the spawn naturally cast would hatch and come to ma-

turity, it would be more than double the amount caught every year.

If the brook trout in the streams protected by a closed season of eight months and until they have come to maturity, will not produce enough fry naturally to keep the streams stocked, how can any one believe or expect a closed season of whitefish and lake trout to keep the Great Lakes stocked?

(From Dwight Lydell, Overseer Fish Hatchery, Mill Creek, Mich.)

Hon. F. B. Dickerson,
Fish Commissioner,
Detroit, Mich.

Dear Sir:—In response to your request for my ideas of our closed season law, I hereby submit what I think of the same.

If we are going to have a closed season for whitefish and lake trout, why not admit at once that the artificial propagation of these fish is a failure, which we know to be false. And if a closed season, for these fish will keep up the supply, why surely it would do the same for every other species of fish that we propagate. The brook trout that are only caught with a hook and line and have a closed season eight months of the year, would soon become nearly extinct in most of our streams, if it were not for the planting of the fry nearly every year. Now, with this fact before us, how can we ever expect a closed season to keep up the supply in our Great Lakes?

A closed season for one month does not cover the spawning season anyway, as the fish in different localities do not spawn at the same time. For example, take the wall-eyed pike of Saginaw Bay and the same of the St. Clair River. In Saginaw Bay they spawn in April, but the St. Clair fish spawn in May. This I know to be true, as I used to finish spawn-taking operations at Saginaw Bay the last of April and go from there to the St. Clair River and commence operations about the 3rd of May, finishing about the 26th of May. This shows why some of our fishermen favor the closed season. You pass a law to prohibit the fishermen at Saginaw Bay from fishing in April and you would hear a howl from that part of the State, but the St. Clair fishermen would pat you on the back and say that law was all right, and just what the State needs. Why? Because their fish would then be the first in the market and would command a good price. Now, just reverse the law and have it for May and you would have all of the Saginaw fishermen climbing over one another to shake your

hand. The same thing exists with all species of fish from all over our State. So it is impossible to please or hurt all by a closed season for one month. But when a man, a fisherman I mean, approves of a closed season, you just investigate and you will find that the law does not affect him in his locality, but puts money into his pocket.

The only species of fish that a closed season would help is the black bass, because they fertilize nearly all their eggs, and if not disturbed while on their beds, they will hatch nearly all the eggs and then protect their young until they are able to care for themselves.

If a closed season for the bass, which fertilizes nearly every egg, will not keep up our supply, what can we expect from other species that probably don't fertilize one egg in a hundred, and spawn promiscuously over a considerable area of ground, then pass on and leave the eggs to their fate, to be destroyed by all kinds of enemies? Why did not we the spring we dredged in the Detroit River right over the spawning grounds every day for two weeks, get some good whitefish eggs? We got some poor ones. This work was done long before the time for hatching. If there were any good ones there to start with, they must have died from some cause or other.

I think I could take one pair of whitefish and artificially propagate their eggs and plant the fry in one lake, and you could take five hundred pairs with a closed season in the spawning season in another lake of the same size, and take out 200 adults each year from each lake, and I would have whitefish in my lake when you had forgotten how fish smell.

Then what is the sense of having a closed season for whitefish and lake trout, when every fishing ground in Michigan of any importance is covered with spawn-takers, at the spawning season? Sixty to ninety per cent. of the eggs taken by the Commissioners are fertilized and hatched and returned to the waters in a good, healthy state; when, if left to spawn naturally, they would fertilize only a small per cent, saying nothing about the chances that small per cent. takes of ever hatching.

I think the sooner a fish is taken from the water after it matures the better it is for the young generation, provided you take the adults at the time when you can return a young generation from them; for what food it takes to provide for one adult one day would sustain a number of small ones for a week. And as for catching the whitefish or any other fish, excepting those that make a spawning nest and guard it, like the bass, I say the time

to take them is when they are spawning, provided you have spawn-takers on the ground. But even if you haven't the spawn-takers on the ground, the loss to the lake would not be as great as it would if the same fish were taken a week before spawning time, for if taken in the spawning season, some of the eggs have been deposited, but if taken before then they are all lost.

I think our small shore fishermen have it hard enough without closing the season and stopping him from fishing the only time in the year he has a chance to make a cent. You practically drive him out of business and give what he makes to the large firms that have large fishing rigs and tugs to follow the fish back to deep water. And any man after having a few years' experience amongst our fishermen and out on our lakes, and understanding the extraordinary gain in hatching results by passing the spawn through a fish hatchery, can come to but one conclusion, and that is that the time of all times when fishing for whitefish and lake trout should not be prohibited, is the spawning time.

I have always found that all fishermen in their honest hearts believe in the artificial propagation of fish, but there is sometimes a limit to a man's endurance. After being hampered for about so long, they will fight, and when a man fights any old weapon will do if he can only come out on top. Some of the arguments used by the fishermen, although they don't believe them themselves, will take every time with a man that does not thoroughly understand fish culture and the spawning habit of fish in nature. Rather than be hampered every two years they would sacrifice the Fish Commission, but if handled rightly they would be the best friends the Fish Commission ever had.

(From J. W. Powers, Overseer State Fish Hatchery, Paris, Mich.)

Mr. F. B. Dickerson,
Detroit, Mich.

Dear Sir:—The question of a closed season for commercial fishing in our Great Lakes having been referred to me for an opinion I beg leave to submit the following:

It is claimed by those who favor a closed season that the fish will increase in numbers and size under this method of protection. Having been engaged in the artificial propagation of fish for the past twelve years, I am forced to hold an opposite opinion. If you are allowed to take the adult fish during the spawning season, obtain the ova, put it in your hatching house, hatch out from

60 to 85 per cent, then put the fry back on the spawning bed in good condition, can nature compete with this? Most emphatically not.

Now, take the other side of the question: We will let the fish alone to spawn naturally. We all know that the whitefish do not make their beds on the bottom, the same as do many of our inland lake fish. They rise rapidly in the water, letting go their eggs at the same time. The male fish is supposed to rise the same time the female does and fertilize the eggs. In my opinion not 10 per cent. of the eggs come in contact with the milt, or, in other words, get fertilized.

Now these eggs sink to the bottom where they remain 120 to 175 days before any hatch. During this time they are exposed to all their enemies, which are too numerous to mention, to say nothing about the constant moving and shifting and washing from the reefs to sand or mud bottom, to be buried up and lost.

Taking into consideration both methods of propagation, which is most likely to increase our supply of commercial fish? I say most surely artificial propagation and the open season.

Suppose the closed season is going to be the means of restoring the supply of commercial fish in our Great Lakes, why not apply the same remedy to all the waters in the country? We have a closed season on brook, rainbow and brown trout and grayling eight months of each year. Is this sufficient to keep up the supply? No. If it were not for the hundreds of thousands that the Commission hatch and plant in the streams every year, in a few years there would be no need of a closed season, or an open season, for there wouldn't be enough fish left to bother with. And it is my opinion that the closed season for whitefish and lake trout, without the help of artificial planting, will result the same as with brook trout.

(From A. C. Babbitt, Overseer State Fish Hatchery, Sault Ste. Marie, Mich.)

Mr. F. B. Dickerson,
Fish Commissioner,
Detroit, Mich.

Dear Sir:—In response to a request for "fish lines," I enclose a collection that has been accumulating for some time

It is quite interesting to pry into nature's methods and note her supreme efforts at reproduction in nearly all forms of submarine fauna; surpassing anything of the kind on the terrestial

sphere. If the magnitude of the effort be surprising, its results, or lack of results, is rather startling.

To illustrate, it will only be necessary to mention a few well-known varieties, beginning with the brook trout, whose habitat is perhaps most isolated—that is, fontinalis has fewer coinhabitants of his domain than do other species inhabiting larger bodies of water, and in consequence fewer obstacles to reproduction are present.

In harmony with its environment, the parent fish is required to make but a moderate effort at procreation, spawning an average of about 800 eggs yearly as a guaranty of the perpetuation of her kind; while the lake trout, whose neighbors are legion, deposits an average of 10,000 ova, showing that the namaycush contends with greater odds. Again, whitefish, of the same genus, living under somewhat similar conditions as the lake trout, are far more prolific in ova, contributing an average of 28,000 eggs annually in her procreative efforts, demonstrating that the species is surrounded, or subject, to still more unfavorable conditions. The sturgeon, representing another genus, deposits about 200,000 ova, while the ling stakes 800,000 eggs that she will inure a posterity.

Notwithstanding this prolificness of ova in these varieties, the net increase is phenominally small, the decimal .002 with brook trout and .000002 in case of the ling would probably more than cover the actual net yearly increae, under strictly normal conditions. It would be impossible to enumerate the different agents of destruction causing such enormous waste; the principal reason, however, is well known to students of nature. Nearly or quite all varieties of fishes are spawn eaters, that is, ova deposited by one species is eagerly sought and devoured by another, the spawning ground of a class becoming in turn feeding grounds for representatives of a different species.

Obviously, depletion of a certain species without a corresponding reduction in numbers of its coinhabitants, would seriously retard nature's recuperative efforts in behalf of the partially exterminated class, as "balance" would be destroyed and unnatural conditions prevail.

As instances of rapid depopulation of virgin waters may be cited two of Michigan's most magnificent streams, the Au Sable and Manistee Rivers. Through a long residence near the head waters of both these streams, whose sources may be compassed in a three-mile walk, I became familiar with their early history.

In 1872 their banks were in a primitive state, their waters

teaming with grayling. The character of the Manistee River, with its clean, sandy bed and colorless water, together with the peculiarly local and home-loving instincts of grayling, made it a favorite fishing ground, affording at the same time unrivaled opportunities for the student of fish nature. Possessed of gregarious habits, hundreds of grayling might have been counted in pools of fifty yards in extent. After five seasons' fishing with hook and line, the hundreds of former times were represented by dozens.

During the five years of depletion, natural reproduction had gone on uninterruptedly, the spawning period being covered by a closed season, and logging operations not yet begun—here was the chance of a lifetime to observe nature's powers of rehabilitation. Results have proven conclusively that her best intentions comprehend but little more than restoration of natural waste, that equilibrium may be maintained. Aboriginal man seems to have been provided for in her pristine plan, his simple needs being simply a factor in the maintenance of balance; that civilized man, however, was an unreckoned force there is no room for reasonable doubt.

The Au Sable River of to-day is an unparallel instance of succession of species. In the space of twenty-five years its original stock of grayling—the accumulation of ages—has been practically exterminated and the establishment of brook trout accomplished, to the extent that old-time repleteness has been attained. Rehabilitation has been accomplished, artificially, in thirteen years, dating from 1885, opposed by the same destructive forces that were responsible for the swift depletion of the original species. If man in various ways was responsible for the destruction of a species, he has also been an active agent in the establishment of its successor, to what extent may be left to inference.

Experiences of twenty years devoted to practical fish culture leads me to deduce the following: That, even though fishing operations on the Great Lakes were suspended absolutely, restoration of partially exterminated species to their original numbers, through natural reproduction, would occupy ages. Moral: let nature furnish eggs in the rough; let fishermen provide means for the preservation of immature fish. Hatchery products can do the rest.

A comparison of natural with artificial propagation of fishes, as to results, may shed a ray of light on the efficacy or otherwise of a closed spawning season for whitefish and lake trout; the enforcement of which must necessarily curtail the output of hatcheries.

If natural reproduction be so slight under the most favorable conditions—such favoring state being simply a natural environment—how much less must be procreative results after balance has been destroyed, in the depletion of a species without corresponding reduction in numbers of its coinhabitants; certainly chances against natural reproduction of a class thus depleted would be multiplied—in fact, it will cease to be natural simply for the reason that the run-down species is handicapped by existence of unnatural conditions. Such conditions now prevail.

It is conceded, I think, that the greatest natural waste occurs during the period of incubation; beginning immediately after extrusion of the ova. During this period more than 99 per cent. of whitefish ova is wasted, through destructive agencies, or lack of fecundation. Thus, the procreative efforts of two adult whitefish would probably be represented by less than 100 fry. Now, it seems equally probable that less than 1 per cent. of these fry reach maturity. If it were otherwise, over-production would ensue—that is, if in a pristine state of nature, procreative efforts of fishes duplicate or double their adult numbers yearly, their habitat would quickly become over-populated—in other words, the waters would not hold them. The sequence is obvious—it means that a pair of adult fishes, working under strictly natural conditions, will add less than an average of one representative of their kind yearly, which lives to reach maturity.

Let us now get at approximate results of artificial propagation of whitefish. It is a well-known fact that an average of at least 70 per cent of artificially handled ova from this species hatches. Allowing a loss of 10 per cent. of the fry in transportation and from other causes, leaves 60 per cent. of the entire number of eggs produced by an adult whitefish, to be returned to the waters in the form of vigorous fry. In brief, a pair of mature whitefish taken from their spawning bed, compensate by a return of 16,000 active fry, as a result of artifice.

Now we will consider the chances for and against the maturing of hatchery products. Incubation proceeded, in hatcheries, in water of a natural temperature; the period being neither shorter nor longer than under natural conditions. In transition from hatchery to habitat, the same conditions obtain. Scientific research develops the ubiquity of organic forms, on which the fry of whitefish subsist. Carefully conducted experiments also prove that hatchery products quickly detect such matter, profiting to the extent that substantial growth is quickly apparent. Thus, in the battle for existence, the products of our hatcheries are placed

on practically an even footing with naturally hatched fry. To be conservative, however, we will allow that but one in 500 of the vigorous, artificially produced fry, reaches an adult age. This extreme concession will give the handsome net result of 32 full grown whitefish to compensate the removal of two parent fishes from their spawning bed, and subjected to piscicultural art.

If properly supported—in the preservation of immature fishes —there is no question as to the adequacy of artificial propagation in the restoration and future maintenance of the fisheries of the Great Lakes. Such support has been denied; resulting in a steady decline in the productiveness of our fishes. That a remedy for this should be inaugurated is imperative. Of the efficacy of a closed spawning season as such remedy and as a means of restoration and the preservation of immature specimens, it is practically nil. Nature's methods of replenishment produce infinitesimal results, which are of no consequence when opposed to the enormous drain of commercial fishermen.

Young fishes, guided by instinct developed in them by successive stages of growth, do not see spawning grounds while yet immature, but instead, infest food producing ranges, where midsummer fishing with murderous, small-meshed pound nets, is responsible for the destruction of untold thousands of this class; from this cause comes the blight upon propagatory efforts. That fishermen have thus so persistently wrought their own undoing seems incredible.

Instances may be cited where a closed period for the spawning function seems to have produced the good results claimed for it. We will take, for example, the pronounced success of artificial propagation of brook trout. Every one knows that wonders have been accomplished in this direction, but to what success has been due to closed spawning months is, perhaps, not so well known. I cannot but believe that to other existing conditions should be attributed the accomplishment of a major portion of the good effects in brook trout culture. That a closed time affects the saving of adult fish, for the time being, there is no room for doubt; but the infinitesimal results of natural propagation add very little its efficiency as a means of restoration or support. On the other hand, suppose conditions were such as obtain on the Great Lakes, that is, let the enforcement of six-inch limit regulations be discontinued, permitting indiscriminate slaughter, regardless of size. Let the open season extend from March 1st to September 1st. Remove the embargo against the sale of brook

trout by interstate laws. Add to this an urgent market and a fair price for brook trout. Contemplate results!

I will say in closing this paper that I give the foregoing letters from men of practical experience for what they are worth. My investigations, I must admit, have educated me in favor of an open season, but I would demand certain restrictions. With no restrictions, and no hatcheries, a closed season is better than nothing. If representatives of the Commission were allowed to go on the boats of the fishermen and take the spawn, without expense to the State; or, in case no representatives of the Commission were present, the fishermen were required by law to strip the mature females and impregnate their spawn and ship it to the hatchery, or when not practical to do so, place it back in the water; and the size of whitefish, lake trout and pike perch be limited to practically mature size; and it be made an offense against the State for fish under these sizes to be found in one's possession, I believe, from the investigations that I have made, that our waters would not be depleted as rapidly as under our present closed season law. On the contrary, I believe a perceptible increase in the fish supply would soon be manifest.

I would also suggest that it be made the duty of Fish Commissions to instruct commercial fishermen in the art of stripping and impregnating the spawn, and that it be the duty of all fishermen to always have in their employ a man who has learned the practical method of stripping, impregnating and handling the eggs. This done, it occurs to me that all fishermen would take a personal and selfish interest in saving every egg possible for the hatcheries.

When fish commissions and fishermen pull hand in hand for the restoration and preservation of our fish supply success will crown their efforts. Let them get together then on some common ground that will be of the greatest good to the greatest number.

Mr. Seymour Bower then read the following paper:

NATURAL VERSUS ASSISTED REPRODUCTION OF CERTAIN KINDS OF FISHES.

If all the members of this society were practical fish-culturists, I should need to apologize for introducing much that is trite and stale to the experienced fish breeder. But a good many of the members, perhaps a majority, have had little or no opportunity of observing nature's plan of reproducing certain

forms of water life; hence, to be understood by all, it has seemed necessary to include much that is obvious to the more experienced.

Ages ago, before the advent of man on mother earth, the reproduction of all forms of animal and vegetable life appears to have been so adjusted to environing conditions that the net increase or decrease of any given form or species was imperceptibly slow. Indeed, since natural laws have not changed, we may well believe that centuries, if not ages, must have elapsed before natural evolution insured an abnormal predominance or led to extinction. The universal law then, as it is to-day in strictly wild or natural areas, was that natural increase barely balanced natural losses, so that the various species for the most part merely held their own.

The entrance of primitive man upon the scene, however, was the injection of a mighty factor into the economy of nature's forces, for man was to be a friend and ally of many existing forms, and an enemy of others. Considered merely as an animal, man's advent projected another and a keen competitor into an arena where the struggle for subsistence and existence was already fierce.

But man's mission, although destructive in some ways, was also creative, for his part in the scheme of creation was to conquer and subdue, and outdo nature by harmonizing and pacifying her warring forces. Being endowed with at least the germs of intelligence, he discovered, in course of time, as his numbers increased, that he must of necessity create if he would survive to multiply and replenish the earth; for otherwise, with man as a merely destructive agent, the earth would eventually be divested of all forms of animal and vegetable life available for his subsistence. In course of time, it dawned upon man that God merely pushes the button and man must do the rest—or starve. The Creator furnished the raw material and formulated the inexorable laws governing it; and while man is powerless to create or annihilate a single atom, he is yet endowed with the cunning to so lead and direct the elements and forces of nature, and to so interpret her reproductive methods, as to multiply results many fold.

And thus down through the ages has man waxed mighty in numbers and power; demonstrating and increasing, from time to time, as he grew in intelligence, his superiority over unaided nature's productive power, through discoveries of latent forces

and hidden resources, and by ringing new changes and playing new combinations on the various forms of matter.

As unaided nature is barely self-sustaining, she is utterly inadequate to cope with both natural and artificial losses; artificial inroads must be recouped through artificial agencies or depletion, if not extinction, is inevitable. Thus, if the hand of man were to-day withheld, and the primitive, closed-season principle of strictly wild or natural reproduction were applied to all forms of animal and vegetable life, the earth would soon be a desert waste, stripped and depopulated.

It is quite natural, for obvious reasons, that nearly all of the discoveries since man appeared that have contributed to his triumphs over nature in the production of animal and vegetable life, should be confined to land flora and fauna. In the very nature of things we cannot hope to control conditions on water as on land, nor to coax nature's secrets from ocean's depths, or even from more restricted water areas, as easily as on land. Investigation has developed the fact, however, that the same unceasing warfare is waged in the waters as on wild or primitive land areas, and that there is the same inability with the varied forms of life to more than hold their own. As on land, we find that the forces of nature merely balance, that natural gains are checked by natural losses; and that the moment man invades this domain and becomes a factor in the losses without directly or indirectly contributing to the gains, that moment depletion begins.

It was evidently a part of the Divine scheme, however, that the waters should not be depleted, but should remain a fixed and unfailing support for man; for, as with life on land, the means were placed within man's reach whereby he might repay the waters, could make complete restitution, through artificial agencies for all artificial losses. It seems strange that the way for man to thus square himself with the waters, a discovery of such far-reaching importance and significance, should have been overlooked until recent years; for when the Creator provided that many of the forms of water life, in order to survive in nature's environment, must develop thousands upon thousands of germs for each recurring period of reproduction—and each germ a possibility for an adult of its kind—He not only proclaimed the self-evident fact that tremendous odds were to be encountered, but purposely left an opening that was a standing invitation to man to investigate and see if these possibilities could not be converted into probabilities or actualities. And this con-

version, by protecting the germs during the germ period, constitutes what is known as artificial propagation—an artificial gain that repays both artificial and natural losses.

And what, it might be asked, has all this to do with laws that prohibit fishing during the spawning season? Of course, this question will not be asked by those who can read words of two and three letters in a fish-cultural primer, for the deductions are obvious, and the application of the general principles laid down, clear and unmistakable.

But right here I wish to digress for a moment and register a vigorous protest, make an emphatic kick, against the further use of the term "artificial propagation," as applied to this method of producing fish. While technically correct, its use is undoubtedly responsible for most of the unwarranted prejudice that exists against this plan of reproduction. To the uninformed the word "artificial" is associated with something wholly at variance with the natural; it suggests the idea that the fish produced in this way are an unnatural substitute, something inferior to, or different from the strictly wild or uncultivated product.

As a matter of fact, there is no more artificiality in the so-called artificial propagation of fish than in a thousand and one other forms of human activity or intervention, or in all forms of production in which the hand and brain of man are a factor in influencing or shaping results. For example, we might, with equal propriety, refer to the ordinary method of raising wheat as the "artificial propagation of wheat" and it would be technically correct to do so.

In the popular mind, fish-culture has too long been discredited and regarded with suspicion through the pernicious influence of this world. We should drop it, throw it off as an incubus, an old man of the sea, that the popular mind may be undeceived and freed from error and prejudice. I earnestly urge all fish-culturists to blacklist it, to strike it from their fish-cultural vocabulary. For myself, I have issued a declaration of independence, turned over a new leaf, sworn off. From now on *protected* propogation is the motto inscribed on my fish-cultural banner.

And now let us return to our fish-cultural kindergarten for a while and try to learn that two and two make four.

In order to propagate fish by protecting their ova, the adults must be caught by fishing in public or private waters during their spawning season. If exposure of the ova in nature's wilds

is productive of greater hatching results than to take the ova and protect it from nature's enemies, or if there is no alternative for natural spawning by reason of circumstances forbidding the saving of the ova, then it is wise to stop fishing during the spawning period. If, on the other hand, catching the spawning fish and protecting their ova during the ova stage results in hatching several hundred young fish where only one would hatch without such protection, then it must be clear that the wisest course is to catch the greatest possible number of spawning breeders; that, instead of preventing their capture by law, the greatest freedom and encouragement should be given, in order that this wonderful life-saving process may be employed to the greatest possible extent.

Where open fishing is allowed during the spawning season, and it is practical to save the ova and develop it to the hatching point in hatcheries—as in the case with the trout and whitefish of the Great Lakes—to deliberately close this season against fishing is to assume that the percentage of ova hatched in nature's wilds is something near the result obtained by intercepting the deposit of the ova and shielding it from all forms of natural dangers. Indeed, advocates of a closed spawning season, to be consistent, must regard the wild as superior to protected incubation, for is not the one deliberately chosen to the exclusion of the other? And is not non-interference with natural spawning their slogan, and the avowed object for which the season is closed?

As closed season laws are enacted for the express purpose of allowing natural spawning, let us consider some of the environing conditions into which the ova in nature are thrown.

The hatching point constitutes the dividing line between two important stages or periods of fish life. During the second stage, that of the fish proper, it is literally true that the big fish eat the little ones and eternal vigilance is the price of existence. Still, almost from their entrance into this period they are able to move about with greater or less facility, and thus to some extent elude their pursuers by seeking a cover or refuge; and later on they may develop offensive or defensive powers.

Not so, however, with fish life in the first or ovum stage. Possessed of no powers of locomotion, the germs lie inert and helpless, at the mercy of all the enemies of ova life. Whatever dangers environ must be encountered without powers of resistence, or means of defense or escape. When lying on the reefs

and shoals, no human power can intervene to stay the destruction—the terrible gauntlet must be run.

The parent whitefish and lake trout, in common with a large group of fishes, do not protect their spawning beds. They select cleaner and more suitable grounds than some other species, but their concern for the welfare of the germs that they deposit with such lavish prodigality ceases when that function is performed.

Then, the wolves of the waters, lurking and prowling, and with whetted appetite, immediately assemble for the feast that a closed season law sanctions and applauds. The spawning grounds become in turn a feeding range; for without exception the spawning grounds of all kinds of fish that do not guard them, become merely a pasture for others. And why not? The ova of all fish are rich, oily, nutritious, a toothsome dainty for even the pampered palate of man. I imagine that the wolves and buzzards and lizards of the waters are even yet winking the other eye, and making merry, and throwing bouquets at themselves, because the solons of two great States were hoodwinked into exploiting the closed season law as a measure of "protection" to whitefish and lake trout.

Nor is the exposure for a period of 125 to 175 days to the tender mercies of spawn-eating animals the only dangers which whitefish and lake trout ova must encounter in nature. The blasting blight of fungus, penetrating and permeating inert masses of unmanipulated ova is of itself sufficient to destroy all germs not completely isolated in the cavities and crevices of rocks and stones. The ova is visited with still other forms of destruction, but these need not be mentioned.

Beyond question, an overwhelming percentage of the loss in the life history of most fishes that do not guard their spawning beds, occurs during the ovum stage. All things considered, it would be a miracle if one in a hundred survived to the hatching point, and odds of five hundred to one would be quickly taken by the most conservative investigator.

The whitefish casts about 30,000 eggs each spawning period; provides, under perfect conditions, for 30,000 young fish; but in nature's domain, under the counterfeit "protection" afforded by the closed season law, these 30,000 eggs probably hatch less than 100 fish. And yet, such meagre results would doubtless suffice for merely natural losses, a posterity would be insured, and the species would hold its own; but to expect, in addition, that such feeble recuperative powers will honor man's drafts indefinitely

without bankruptcy, is to expect to find a Klondike at either end of a rainbow.

Compare the results of this delusive and fallacious scheme of protection with the bona fide protection afforded through open fishing and protected environment for the ova. By this plan a single spawning of the whitefish, 30,000 ova, will produce 15,000 to 27,000 young fish, varying according to circumstances. Allowing that but one in three of the breeders not spawned out when caught is in spawning condition, and still the closed season natural spawning plan of producing whitefish is overwhelmingly outclassed.

But, instead of eagerly seizing the only brief opportunity that is allowed to thus create where nature destroys and save where nature wastes, the law says no, we will blindly turn from this golden opportunity whereby we may not only recoup for the fish removed during this period, but also for those taken at other times, when recompense is impossible.

Masquerading and deceiving, through the seductive influence of the word "protection," the closed season law commits the unpardonable folly of denying the opportunity to intervene and rescue and vitalize millions on millions of germs otherwise doomed to certain destruction. To thus protect by destroying is to add by subtracting and multiply by dividing.

Although the hatching percentage of brook trout in nature is undoubtedly much higher than that of the lake trout and whitefish, yet no better illustration of the pitiful inadequacy of natural propagation need be cited than the trout streams of Michigan. Hundreds of non-indigenous streams were quickly stocked through the agency of protected propagation. Fishing has been limited to hook and line for a season of four months, alternating with a period of eight months' rest. Clearly this was a most favorable opportunity for unaided nature to prove her ability to stand up against nature's losses and the inroads of man; in short, for the closed season propaganda to vindicate itself. Surely a closed spawning season should be more than able to stand the strain of four months' angling if it is expected that the same remedy will sustain the wholesale methods of commercial fishing. But we find that in the more accessible streams the stock soon dwindles, fishing grows poorer, and periodical contributions from the hatcheries, to reinforce nature's feeble efforts, are necessary.

If the natural spawning for which closed season advocates so plausibly contend be the unfailing panacea for toning up

and sustaining our commercial fisheries, consistency demands that we close our brook trout hatcheries and rely on the same remedy for the streams, where the conditions are much more favorable for nature to sustain herself. If a new stream or system of streams is to be stocked, transplant a few adults and let nature, with a closed spawning season, do the rest.

No doubt much confusion arises in the lay mind because practical fish-culturists favor an open spawning season for lake trout and whitefish and a closed one for brook trout. If the latter were like the former in their habits and movements at spawning time, open fishing would be the wisest possible plan that could be adopted, for then millions of ova that are now wasted could be saved and hatched, and there would be no necessity of going to the expense and trouble of holding a stock of adults under control the year round for the sole purpose of procuring a supply of ova. But with nature's stock of brook trout, there is no practical way to save the ova, if open fishing were permitted, and hence for wild brook trout there is no alternative for natural spawning. At spawning time the breeders disperse to innumerable brooks, where, if fishing were allowed, they would fall into an indefinite number of hands that could not if they would, save the ova and hatch it.

But lake trout and whitefish, like a good many other species, instead of scattering, concentrate their forces at spawning time. The reproductive instinct assembles the parent stock into schools on a comparatively few well-defined and well-known shoals, thus making it practical to cover all fishing points with experts prepared to save the ripe ova. The expense of holding a breeding stock in constant confinement, as conditions compel us to with brook trout, is rendered wholly unnecessary

It may be noticed, in passing, that when a stock of brook trout are held for breeding purposes, thus giving us an option on propagating them by either natural or protected methods, every possible precaution is taken to prevent the former. According to the closed season creed, we commit the unpardonable sin of "interfering with" and "disturbing" the sacred function of natural spawning. If we followed the creed and allowed the breeders to bed and spawn in the ponds and raceways, the meagre hatch would, if carefully reared, recruit the ranks of the adults, but there wouldn't be any surplus for distribution. By violating the creed, however, and running the ova through a hatchery, the gain in hatching results enables us to distribute a million fish annually from a stock of two or three thousand

breeders, and still retain enough to keep up the parent stock. But when we come to whitefish and lake trout the closed season law enforces adherence to the creed plan of merely breaking even, and refuses an option on a plan that is absolutely certain to yield immense gains.

To illustrate the common sense, practical plan of "cropping" certain waters, like similar areas of land, let us note the conditions of whitefish life in Crystal Lake, a beautiful sheet lying in Benzie County, near the shores of Lake Michigan. This lake is one of the very few inland waters of Michigan that contain whitefish, or that are capable of supporting the species in considerable numbers. Judging from the number that assemble on its stony shoals during the spawning month of November, the lake probably contains a stock of twenty to forty tons of adult whitefish. As fishing is limited by law to methods that are ineffective so far as whitefish are concerned, these fish serve no useful purpose, except as their ova and young contribute to the food supply of other and less valuable denizens.

But so far as the production of whitefish is concerned, this fertile area, capable of yielding an annual crop equal to the present matured stock, might as well be so much desert. It is obvious that if all of the adults were removed in any one year the sources of food that sustained them would support a like number the following year, and so on indefinitely. To reap this crop year after year, however, fishing by effective means must be allowed, and a due proportion must be taken from their spawning grounds, so that sufficient ova may be touched by the magic wand of protected propagation to provide for future crops. Each crop must be reaped as fast as matured, else there is no room for a succeeding one. But without protected propagation we would soon reach the last link in the chain; with it we would have the link that unites the ends into an endless circuit.

And what is true of Crystal Lake is true of the Great Lakes and many other waters. The trouble with production in the Great Lakes is that far too many whitefish and trout are slaughtered in immaturity, and too few adults are permitted to reach their spawning grounds to allow the saving grace of protected propagation to be employed on a scale of sufficient magnitude. It seems a great pity that the parent fish when approaching their spawning grounds, heavily laden with ova nearly matured but still worthless for reproductive purposes, should be intercepted. A few days of closed season at this particular time would be

the kind of protection that protects. By postponing their capture for a few days, until the spawning grounds were reached, the wanton waste of an untold number of germs might be prevented and, through the magic touch of man, be called into life.

The saving of adults that is claimed for the closed spawning season is more apparent than real, for a season closed at any time, whether by law or the weather, merely postpones their capture. There is no real gain or increase of adults—their numbers are not added to. Thus, the adults that are shielded in November are for the most part caught before the following November. They are protected from capture for the time being, but in so doing we lose the enormous difference in hatching results between natural and protected methods.

A reckless disregard of the principles herein set forth has brought some of the Great Lake fisheries to a point where it may become necessary, for a time, to reap our annual crop of whitefish and lake trout as the farmer does his grain, namely, when the seed is ripe. Thus, if we would open our present closed season and close our present open season, the production of the young, through the agency of protected propagation, would be so greatly increased that but few seasons of this kind of sowing and reaping would be required to increase the annual crop to the highest productive limit. Until this limit was reached the more we would thus reap, the more we could sow, and the more we would thus sow, the more we should reap. With fish as with grain, it is just as essential to reap at the right time in order to be able to sow as to sow at the right time in order to reap.

In the vegetable world we endeavor to destroy or exterminate what is obnoxious by attacking it while it is yet green, but what we would save for reproduction we protect until it is ripe. Thus, the farmer cuts his grain when ripe and his weeds and thistles when green. During most of the year our commercial fish are treated as weeds and thistles, killed off without limit while their seed is green. And then, when the seed is ripe, instead of treating them as grain, the closed season law caps the climax of economic blindness and folly by saying, hands off, these fields of waving gold, nodding and beckoning for the sickle, must remain untouched; the seed must return to mother earth undefiled, the contaminating touch of the hand of man must not supervene, for then the sacred function of reproduction would not be strictly natural!

Under the circumstances, so drastic a measure as closing

the entire open season would not of course be wise, nor is it necessary. But to hold on to the present closed season is to "go forward backwards" with accelerated speed. Under the conditions that obtain throughout the Great Lakes, a closed spawning season for whitefish and lake trout is simply suicidal. By a false pretense, like a wolf in sheep's clothing, a closed spawning season for many kinds of fish does not protect but destroys them.

If we haven't enough hatcheries to shelter all the ripe ova available, the remedy is not to force the hatcheries already established to close by preventing the capture of spawning fish, but to provide additional capacity, so that all the ova that it is possible to reach may be transferred from a scene of tumult and anarchy, may be rescued from the riot and chaos of nature's savagery and brought under the beneficent and fostering care of man.

Mr. Whitaker: Before it is overlooked, I think the matter had better be taken up that was laid over, to designate some one to represent this society in response to the letter of Mr. Cacheaux. I present the name of Prof. Birge to represent this society in that capacity.

Mr. Clark: I will say that I am going to try to go to the Paris Exposition.

Mr. Whitaker: I suggest in addition to Prof. Birge, the name of Mr. F. N. Clark to act on that committee.

Mr. Bower: I would suggest also the name of Mr. Whitaker.

Mr. Stranahan: I move that three be appointed—Prof. Birge, Mr. Clark, and Mr. Whitaker—to attend and represent this society on the committee referred to in the communication.

The motion was seconded and carried.

Mr. Whitaker then read a paper by Mr. Livingston Stone, Superintendent of the United States Fish Commission Station, Cape Vincent, N. Y., on "The Origin of the American Fisheries Society," which follows:

THE ORIGIN OF THE AMERICAN FISHERIES SOCIETY.

On the first day of November, 1870, the following call was sent to various persons who were known to be interested in the culture of trout:

"The undersigned, desirous of promoting the interests of fish culture, call a convention of pisciculturists, at the Skating Rink, City of New York, December 20, 1870, at 11 o'clock a. m.

"The design of the convention is consultation for the protection of our interests, and, if thought best, to organize a permanent association.

"(Signed) "W. CLIFT,
"A. S. COLLINS,
"J. H. SLACK,
"F. MATHER,
"L. STONE.

"Mystic Bridge, Ct., November 1, 1870."

This was the very first step taken towards the forming of the American Fish Culturists' Association, now known as the American Fisheries Society.

The prime mover in the issuing of this call was Rev. Mr. W. M. Clift, of Connecticut, who was carrying on, at that time, a large fish and stock farm at Mystic Bridge. It is undoubtedly true that the chief motive for issuing the call was, as the call plainly states, a desire to do something for the protection of the interests of fish culturists. It is also true that from the very first moment of the assembling of the meeting, as will be seen later on, the mere pecuniary interests of fish culturists became a secondary consideration. It should be stated here, by way of explanation, that the term "fish culturist," at that time, meant trout breeder, for there were then no practical fish culturists in this country except the trout breeders, and it may also be added that trout breeding meant the raising of the brook trout, or speckled trout, of New England and New York, now, I think, generally known all over the world by its Latin cognomen, fontinalis.

The call was accordingly addressed particularly to those engaged in the raising of trout.

It is true that the State of New Hampshire had created a Fish Commission six years before, and the example had been followed by several other States. The Fish Commission of Massachusetts had already contributed to the world, through its reports, some of the most valuable information ever published on the subject of fish culture. Seth Green had already done successful work in hatching shad, the writer had built and operated a large salmon hatchery in New Brunswick, various States had experimented successfully on narrow lines in propa-

gating other fish than trout, but the extensive and varied work of the United States Fish Commission, created a year later, had not been begun, and hatching work in this country on all other fish than brook trout (S. fontinalis) had, up to that time, been experimental rather than practical, so that fish culture not only meant trout culture, but trout culture meant the breeding of the fontinalis, or brook trout.

It was to brook trout breeders, therefore, that the above-mentioned call was issued, and the object of the call was to form an association for the protection of their commercial interests. But upon the assembling of the meeting, it became apparent at once that something altogether broader and less personal was in the minds of those present, and I think I can truly say that that which I may perhaps term the selfish feature of the call scarcely ever showed itself at all in the meeting. From the very beginning of the meeting, the little group of men assembled, appeared to be actuated more by an earnest and generous interest in the cause of fish culture than by a desire to promote private ends. The spirit that prevailed seems to me to have been that which has characterized the meetings of the Association ever since. It was comprehensive rather than narrow, devoted rather than self-seeking, and good-will to all prevailed over sordid feelings of competition with each other. If I remember rightly, hardly a word was said about regulating the prices of fish culturists' products or increasing the pecuniary profits of the business. Not a resolution bearing upon the pecuniary side of the subject was passed. It seems as if this handful of pioneers had a foresight of greater and better things. At all events, if the pecuniary considerations had anything to do with prompting the call of the meeting, they had no place in the meeting itself. The meeting having come to order, and a temporary Chairman and Secretary having been chosen, it was voted at once and unanimously to form a permanent organization, and Dr. Edmunds and the writer were appointed a Committee to draft a Constitution. Each member of the Committee presented a separate form for a Constitution, the one offered by the writer being the one finally adopted.

As the records of the early meetings of the Society have been lost, it may not be out of place to present here the original Constitution, as it was adopted at the time of the organization of the Society.

It is as follows:

CONSTITUTION.

ARTICLE I.—Name and Objects.

The name of this Society shall be "The American Fish Culturists' Association." Its objects shall be to promote the cause of fish culture; to gather and diffuse information bearing upon its practical success; the interchange of friendly feeling and intercourse among the members of the Association; the uniting and encouraging of the individual interests of fish culturists.

ARTICLE II.—Members.

All fish culturists shall, upon a two-thirds vote of the Society and a payment of three dollars, be considered members of the Association, after signing the Constitution.

The Commissioners of the various States shall be honorary members of the Association, ex-officio.

ARTICLE III.—Officers.

The officers of the Association shall be a President, a Secretary and a Treasurer, and shall be elected annually by a majority vote.

Vacancies occurring during the year may be filled by the President.

ARTICLE IV.—Meetings.

The regular meetings of the Association shall be held once a year, the time and place being decided upon at the previous meeting.

ARTICLE V.—Changing the Constitution.

The Constitution of the Society may be amended, altered or repealed by a two-thirds vote of the members present at any regular meeting.

(Finis.)

It is rather interesting to note how few changes have been introduced into the original Constitution during the twenty-eight years of the Society's existence.

It is also sad to note how few of those who took part in the organization of the Association have lived to see its growth. There is no one now living, I think, except Dr. Edmunds, then Fish Commissioner of Vermont, and the writer, who were present at this first meeting, or who took an active part in the organization of the Society.

A report of the meeting of organization that appeared in the New York Citizen, which, by the way, was the paper of Hon.

Robt. B. Roosevelt, who afterwards became such an ardent and influential supporter of the Association, read as follows:

"The Constitution having been adopted, the following officers were chosen for the ensuing year: W. Clift, Mystic Bridge, Ct., President; Livingston Stone, Charlestown, N. H., Secretary; B. F. Bowles, Springfield, Mass., Treasurer.

"It was then moved that an effort be made to secure an exhibition of live fish at the next meeting, and that the following gentlemen be requested to prepare papers, to be read at the next meeting, on the subjects annexed to their names:

"A. S. Collins—On 'Spawning Races and the Impregnation of Eggs.'

"J. H. Slack—On 'The Culture of Black Bass.'

"W. Clift—On 'The Culture of Shad.'

"Dr. Edmunds—On 'The Introduction of Salmon into American Rivers.'

"B. F. Bowles—On 'Land-Locked Salmon.'

"Dr. Huntington—On 'Fish in the North Woods of New York.'

"Livingston Stone—On 'The Culture of Trout.'

"It was decided to hold the next meeting and exhibition in connection with the New York Poultry Show, next year. It was voted to send a report of the meeting for publication to the New York Citizen and Round Table, the New York Tribune, the Springfield Republican, the New York Poultry Bulletin, and other papers at discretion; and the Secretary was instructed to mail the published reports to fish culturists generally."

Following is an account of the first annual meeting of the Association, taken from a New York paper of February 8, 1872:

"At the afternoon session yesterday the following officers were elected for the ensuing year: President, Wm. Clift; Treasurer, B. F. Bowles; Secretary, Livingston Stone; Executive Committee, Seth Green, J. D. Bridgman and A. C. Rupe.

"A paper was read by A. S. Collins on spawning races and impregnation of eggs; a paper by W. Clift on the culture of shad, and a paper by Dr. Edmunds on the introduction of salmon into American rivers.

"A box of a hundred trout eggs that Mr. Stone had taken by the Russian or dry method were examined, and 97 per cent. were found to be impregnated. The interest of the meeting was very much increased by remarks interspersed during the intervals by Seth Green.

"At the evening session B. F. Bowles read a paper on 'Trout in the North Woods,' and L. Stone read a paper on 'Trout Culture.' Discussion ensued on the dry method of impregnation, and the expression of those who had used the method was in its favor. G. S. Page moved that a memorial be presented to Congress for a more general distribution of ova throughout the country, and the motion was carried.

"Interesting remarks were made by Hon. Horatio Seymour on fish culture. . . . . He suggested that an effort be made to learn more in regard to fish culture in China and Japan, and also to obtain desirable varieties of the fish of those countries and introduce them into the United States. In pursuance of the suggestions, Messrs. G. S. Page and the President, Mr. Clift, were appointed a committee to communicate with various foreign countries and take measures for an interchange of fish with those countries.

"Gov. Seymour and Livingston Stone were appointed a committee to take charge of the publication of the proceedings of the Association.

"To-day's proceedings.—The Association met at 10 o'clock this morning (February 8, 1872), President Clift in the chair. Some routine business was transacted, when the following resolutions were offered:

"1. To petition the Government to establish two or more fish hatching establishments—on Puget's Sound and the Atlantic Coast.

"2. To seek foreign exchanges.

"3. For a permanent fish exhibition in Central Park.

"4. That the headquarters of the Association be at No. 10 Warren street, New York, where the next meeting, in February, 1873, will be held.

"5. Recommendations to all States to encourage fish culture.

"Messrs. Dr. Streeter, of New York; S. Wilmont, of Canada, and S. F. Band, of Washington, were made honorary members.

"After miscellaneous business, the Association adjourned."

Permit me to close this somewhat lengthy paper with some extracts from the report of my own work as Secretary, during the first year of the existence of the Association:

CIRCULATION OF LAST YEAR'S REPORT.

"In order that the meeting of practical fish culturists in New York, December 20, 1870, the first in the way of organization,

in this country, might be generally known, a copy of the report of the meeting was sent to all the leading newspapers in New England and New York, and to some farther West and South, and also to nearly 200 practical fish culturists in various parts of the country.

"I am happy to say that the newspapers in almost every instance printed the report in full or noticed it in some way.

"THE AGASSIZ CIRCULARS.

"For some time previous to the meeting on organization I had held a correspondence with Professor Agassiz on topics relating to fish culture, in the course of which the Professor mentioned a labor in which he is now engaged, of preparing an illustrated work of all the salmonidae of this continent, showing the variations of age, sex, locality, and the like; and after the formation of the Association he suggested that the Association should use its influence in furnishing material for this work. . ..

"I consequently take the liberty here to remind you that this is a most valuable work which Professor Agassiz is undertaking, and one which will be unsurpassed by anything of its kind in the world, and I warmly commend it to the attention and interest of the members of the Association.

"Mr. Agassiz cannot finish his work unless the requisite material is furnished him, and the members of this Society and all interested cannot do the distinguished naturalist a greater kindness, nor the cause of fish culture a better service, than by sending him, as opportunity permits, specimens of the various individuals of the salmon family. . .

"THE ST. LAWRENCE RIVER CORRESPONDENCE.

"During the session of the High Joint Commission at Washington last spring, I received a letter from Hon. Stephen H. Ainsworth, asking me, as Secretary of the Association, to request our State Congressional delegation to use their influence with the Commissioners to adopt some measure towards removing the obstructions in the River St. Lawrence, which prevent the salmon from ascending its tributaries. I accordingly wrote to our New Hampshire Senators and Representatives on the subject." Of the correspondence which resulted, I will merely offer here one letter, and this chiefly because the name of the distinguished writer has been recently brought to the country's attention by the death of his son and namesake in the famous charge of the heroic Rough Riders in Cuba:

Department of State,
Washington, April 20, 1871.

Hon. E. A. Hibbard, House of Representatives:

Sir—In answer to your note referring to a communication from Mr. Stone on the subject of salmon fisheries in the tributaries of the St. Lawrence, I have the honor to say that Mr. Stone's letter was one of many interesting communications on the same subject.

As the obstacles to the free access of the salmon to these rivers are matters within the control of local or provincial legislatures of the British colonies, I have brought the subject and laid several of the letters informally before Sir John Macdonald, from whom, I understand, that the obstructions complained of are prohibited by the Canadian laws, and that the authorities are constant in their efforts to prevent them from being placed in the river, and patrol the river for that purpose, but find it very difficult to prevent the violation of the laws on the subject. He has taken the letters, and assures me that no efforts will be wanting to prevent or punish future violations.

Very respectfully yours,
HAMILTON FISH.

"NEW MEMBERS.

"In the course of the year I took occasion to write to most of the practical fish culturists of this country, whose acquaintance I had made by correspondence or otherwise, to the number of about 200, extending to them an invitation to join the Association. These letters met with various replies, some few were not answered at all, but they were, on the whole, well received, and the replies in most cases contained expressions of interest in the prosperity of the Association.

"The notification circular of the present meeting was sent to all professional and amateur fish culturists whose names were in my possession, and to the Fisheries Commissioners of the various States, and was generally noticed in the newspapers and agricultural periodicals.

"In conclusion, I will merely add that in the course of the year I have mailed 500 letters on business of the Association, and nearly 1,000 circulars and papers.

"LIVINGSTON STONE,
"Secretary A. F. C. A.

"Albany, February 7, 1872."

The next annual meeting of the Association was held about a year later, but the Association was no longer in its infancy. It was now on a firm foundation, and has since contined to grow in strength and favor.

Mr. Whitaker: I move you, Mr. President, as a recognition of this distinguished man's work in this connection, that a vote of thanks be given Mr. Stone for his able paper.

The motion was duly seconded and unanimously carried.

Mr. Clark: You will notice in Mr. Stone's paper that the Society was called The American Fish Culturists' Association, and at the proper time I wish to take up that matter of a change of name. I think the present name of this Society is inappropriate, "The American Fisheries Society." That does not show what this Society is. It merely shows that we are fishermen. The name of the Society should be changed back to the "American Fish Culturists' Association." It carries more of the idea of fish culture with it.

Mr. Whitaker: You will remember Mr. Mather referred to this same subject two years ago and said the reason the name was changed was that the scope indicated by the old title was too narrow.

Mr. Clark: Away back ten years ago, when I think Mr. Whitaker was Secretary of the Michigan Fish Commission, this same question came up. I think the name certainly ought to be changed in some way.

Mr. Barrett, of North Dakota, was then introduced to the delegates by President May, who stated that Mr. Barrett would say a few words on the subject of "Fish Culture in North Dakota."

Mr. Barrett said: Mr. President and Gentlemen: Our State Legislature eight years ago created a Department of Irrigation, Forestry and Fish; the duties whereof have devolved upon myself from that time until this. I give my time and attention to forestry, at the same time fish culture received much of my attention.

I will say that we have no State fish hatchery. The fish are obtained from the United States Fish Commission. It is very difficult to obtain fish from that source for the simple reason that the demand throughout the United States for fish is far in excess of the supply the Government has, and yet North Dakota has received a fair amount of fish, for which we feel very thankful.

Some lakes received fish to the amount of 30,000. Last year I distributed a whole carload of fish.

In my annual report I pointed out the various ways to cultivate fish and how fish could be protected, etc., and I also presented various systems for doing it, and one of them is this, and I have advocated it for ten years. It is what I call the Home Fish Culture System; that is, raising fish on the farms, the water coming from our artesian wells, being lifted by means of wind power and other means from the springs on the farms, and from brooks and artesian wells.

I will say we have made pretty fair progress on some points. There are some men who have been raising fish in that way in an artificial manner on their farms for a number of years. Year before last I furnished one man some thousand brook trout for a little stream on his farm, the source of supply coming from a spring which he had dammed up. A good many artificial ponds are made in that way.

I have been experimenting in raising fish in water lifted into tanks by means of wind-mills, and we have made good progress in that direction. What has interested me most is my success in raising fish in artesian water. I have been advocating this system for ten years and whenever I have had an opportunity I have been experimenting. Last winter I devoted some months to experimenting with fish in artesian water, and I am pleased to say that I met with excellent success. I don't say that my success proves that fish can be raised successfully in artesian water; I want to experiment further. Thus far it has been very encouraging. I know in South Dakota a large number of fish are raised in artesian water, the German carp especially. The fish we experimented with are yellow perch and some other fish, and there were no failures. I desire to say, in conclusion, that this idea can be worked out. It may be made practical in different parts of the West. In North Dakota we have 700 flowing artesian wells. If we could have the fish raised on the farms it would be of great advantage to our farmers and a source of some income.

That you may be somewhat impressed with this fact that fish can be raised in artesian water, and good fish, too; fish that are desirable for food, I will show you some of the fish I experimented with last year. (Mr. Barrett here exhibited specimens of preserved fish.)

Mr. Clark: I move that we now take a recess until to-morrow morning at 9 o'clock.

The motion was duly seconded and carried, and a recess was taken until Thursday, July 22d, 1898, at 9 a. m.

THURSDAY MORNING SESSION.

JULY 21, 1898, 9 A. M.

President May: The meeting will please come to order. I think we had better have read the reports of such committees as are ready to report.

Mr. Whitaker: I think that the Committee on Time and Place of Meeting had better report first. The committee has no written report, but submits the following report:

Your Committee on the selection of time and place for the next meeting of this Society, begs leave to submit the following report. We met and considered the various propositions made to the Society for the next place of meeting. We had invitations from Milwaukee, Philadelphia and Niagara Falls. Taking the whole matter into consideration, the central location of the place and the fact that we have already met in the West two years in succession, it seems to us that it is best to go East, to some central point. Your Committee, therefore, respectfully submits Niagara Falls as the place of the next meeting. After consulting with Prof. Birge yesterday and this morning he suggests it would perhaps more nearly meet the convenience of the men of the colleges who are engaged in biological work and the college examinations, if the fourth week in June were selected. I know the field work on the lakes on which the United States Commissioners have entered will begin hereafter, in all probability, on the first of July, and that would tie up some of these men after that time. We, therefore, recommend Niagara Falls as the place of meeting, and the 28th and 29th of June, 1899, as the time.

President May: You have heard the report of the Committee, what is your pleasure?

Mr. Gunckel: I move that the question be divided and a vote be first taken on the location.

Mr. Peabody: I would like to present the claims of Milwaukee and of Wisconsin very strongly. The climate, situation on the lake and the interest in fish culture taken by the people of Wisconsin and all that sort of thing, we think makes Wisconsin and the city of Milwaukee the most desirable point to meet. The city of Milwaukee has extended you a very cordial invitation, as have the State Fish Commissioners.

Mr. Spencley: If it is thought best to have the Society meet

at Niagara Falls, I would like to have it recommended that we meet at Milwaukee the succeeding year.

Mr. Whitaker: I believe it is not within the province of this Society to select a meeting place for the year following next year. Of course we all appreciate the fact that Milwaukee would be a delightful place to meet and we would receive entertainment there that we might not receive at Niagara Falls, but the thing that appealed to the Committee was, that we have now met two years in the West and should get nearer the bulk of our membership another year. We don't want them to think that we have taken this Society to the West and propose to keep it here. We should meet further East next year.

Mr. Spencley: While I support Mr. Peabody's remarks as to his recommendation concerning Milwaukee, I am willing that some other place be selected, because I think in 1900 Wisconsin will be in a better position to entertain the Society than they are now. In other words, the new trout hatchery will be in better shape. I therefore will acquiesce in the report of the Committee.

Secretary Whitaker: I move the adoption of the report.

Mr. Clark: I heartily agree with the report of the Committee on the place of meeting. Am I to understand that this question is to be determined now?

President May: Yes.

Mr. Clark: Just the location?

President May: Yes.

Mr. Dale: I have an invitation from the Pennsylvania Fish Commission for the Society to meet in Philadelphia. I yielded to Omaha last year, but I think it would be more advantageous, as Mr. Whitaker said, to go to a more central point than Philadelphia.

President May: It has been moved and seconded that the report of Committee on Time and Place of next meeting of this Society, fixing the place at Niagara Falls, be adopted; are you ready for the question?

The question was put and unanimously carried, and Niagara Falls was selected as the place for the next annual meeting of the Society.

President May: Now as to the other part of the report, as to the date, the Committee have recommended the 28th and 29th of June, 1899.

Mr. Clark: I really hate to rise on this point, because last year I had so much to say about the time of the meeting. Last year it was put off really on account of many of the United States Fish Commission men. I would prefer to have it come at another time, but I suppose perhaps Prof. Birge and the other University men would not find another date convenient.

Prof. Birge: I think the Society ought to vote to accomodate the greatest number. It is obvious, as the colleges do not close until the fourth week of June, that the college men could not attend on a later date, at the same time we have but two present at this meeting, and I don't know that it is worth while to put the Society to an inconvenience on their account. I have enjoyed this meeting and I should expect to attend the Niagara Falls meeting if possible, but at an earlier date it would be entirely impossible.

Mr. Nevin stated that he favored July 12th.

Mr. Whitaker: It is a matter of indifference to me personally, but we ought to fix the time of meeting so that we can get the largest attendance. The suggestion made as to the date, I think, arose out of some conversation I had yesterday with Prof. Birge. We all know that the interest of the meeting a year ago at Detroit, without being invidious, was very largely contributed to by the gentlemen from the Universities, and it is very desirable, if possible, to have them present next year. I had some conversation with Prof. Birge with a view of accommodating ourselves to the convenience of these gentlemen. He told me the third week in June would be examination week, he thought, and from what he said I thought probably the fourth week in June would be as convenient as any; that was the idea on which the Committee made its report.

Mr. Clark: Of course the United States Fish Commissioners don't want to do anything at all that is going to interfere with the work of Prof. Reighard; but that work is to be carried on not only during the summer but is to be continued continuously, probably next year if the appropriations are large enough to permit it. I certainly don't want to say anything further. I think, take it all in all, it would be as well to have it on the 28th of June.

Mr. Stranahan: With reference to this matter of the professors and biological work. Suppose the work was interfered with in July, they would only have to lose a half a day, aside from the time that they devote to the convention. It would be a pleasant trip for them, and there is no doubt they would like a little rest after a couple of weeks' work. I don't believe it will interfere with one of these men that are at Put-in-Bay.

Prof. Birge: That is my feeling. I move that it is the sense of this meeting that the date of the next meeting be fixed for the 12th of July. I offer this as an amendment to the report of the committtee as to the time of meeting.

President May: The question is on the amendment, placing the date July 12th.

The motion was then put by the president, who said: I am in doubt as to whether the motion carried or not. I will ask for a rising vote.

A rising vote was taken, which resulted in four members voting for the amendment and six members voting against the same, and the amendment was lost.

President May: The vote now will be on the date named by the committee, which is the 28th and 29th of June, 1899.

The motion was seconded and carried.

Mr. Gunckel then read the report of the committee on nominations and moved the adoption of the same.

The motion was duly seconded and unanimously carried, and the following gentlemen were named as officers for the next year:

President—George F. Peabody, Wisconsin.
Vice-President—William H. Bowman, New York.
Recording Secretary—Herschel Whitaker, Michigan.
Corresponding Secretary—J. E. Gunckel, Ohio.
Treasurer—L. D. Huntington, New York.

Executive Committee—J. A. Dale, Pennsylvania; E. E. Bryant, Wisconsin; J. J. Stranahan, Ohio; F. N. Clark, Michigan; J. W. Titcomb, Vermont; W. L. May, Nebraska; Dr. J. A. Henshall, Montana.

Secretary: I understand the next paper in order is the paper of Prof. Birge on the Relation between the Areas of Inland Lakes and the Temperature of the Water.

Prof. Birge: Mr. Clark is anxious to hear the paper by Prof. Bumpus, and if there is no objection I will read it first.

Consent was given.

Prof. Birge then read a paper prepared by Dr. H. C. Bumpus, entitled "The Identification of Adult Fish that have been Artificially Hatched," which follows.

THE IDENTIFICATION OF ADULT FISH THAT HAVE BEEN ARTIFICIALLY HATCHED.

Although the planting of artificially hatched fish in the inland waters may, and often does, yield immediate and undoubted increase, the results of fish culture along the coast are often much less definite, and conclusions are too often based upon the mere opinions of observant, but unscientific, fishermen. The recent excessive abundance of cod along the shores of New England, is probably the result of the extensive operations at the Woods Hole Hatchery. The facts that these fish were small when they first appeared, that they have since increased in size, that they have occurred in localities where cod had never before been caught, and that they are reported to be of a different color from the native variety, are interesting, although to the skeptical they are not absolutely convincing. There is need of some scheme whereby the adults of fish hatched artificially may be distinguished from those native to the locality.

To mark the fry is, of course, out of the question; but is it not possible that the fry mark themselves, i. e., is there not a slight difference between the fish of the same species, but of different, even though contiguous, localities? And if there is a slight difference, does it not present itself in a measurable manner? We all know that the bony rays, which support the dorsal fins, are subject to variation, both in respect to their length and their number. In fishes which have a large number of fin-rays, the variation is often considerably greater than those possessed of only a few. This variation is above or below a certain average or mean number, and the amplitude of variation (that is, the amount of normal increase or decrease in the number) is definite for any given locality. During the latter part of March of the present year several hundred flatfish were examined at the station at Woods Hole with the purpose of determining the amount of variation in animals collected at different localities. The diagram marked "Woods Hole" is intended to illustrate the variation in the number of dorsal fin-rays presented by one hundred

flatfish collected near the Laboratory. On this diagram each of the red marks represents a fish, and the marks are arranged in rows according to the number of fin-rays. Thus at the left of the diagram it will be noted that one fish had only 62 dorsal fin-rays, seven fishes had 63 fin-rays, twelve fishes had 64 fin-rays, twenty-two (the largest number of individuals) had 65, eighteen had 66, twenty-one had 67, and from there on the number of individuals almost constantly decrease, nine having 68, six having 69, one having but 70, one having 71, and two having 72. A curve, then, drawn through the culminating points of the several columns is a curve that represents, at least roughly, the variation in the number of dorsal fin-rays for this specific locality. The curve indicates that no matter how many flatfish may be collected at Woods Hole, specimens having less than 62 fin-rays will be extremely infrequent, while those having slightly more than 72 fin-rays may occasionally occur. The variation is about an average which lies near the column 66.

If we now tabulate the fin-rays of an equal number of flatfish from another locality, it is evident that if the fishes in both localities are alike, the curves will coincide. If, however, the fishes are different, even slightly so, the lack of coincidence in the curves will indicate the difference.

The diagram marked "Waquoit" is based on the variation in the number of the dorsal fin-rays of one hundred flatfish taken at Waquoit, from a small bay only eight miles east of Woods Hole. Compared with the first curve, the Waquoit curve lies further to the left, has a shorter base and a less altitude. The Waquoit collection contains fifteen fishes which have a less number of fin-rays than any fish collected at Woods Hole, a striking difference when one considers the small number of fish examined. Moreover, the right side of the Waquoit curve is almost equally characteristic, and the average number of fin-rays in the Waquoit fish is very evidently less than the average number at Woods Hole. The Waquoit fish are more variable, the ampliture at Woods Hole being 62 to 72 (11 points), while the ampliture at Waquoit is from 60 to 71 (12 points).

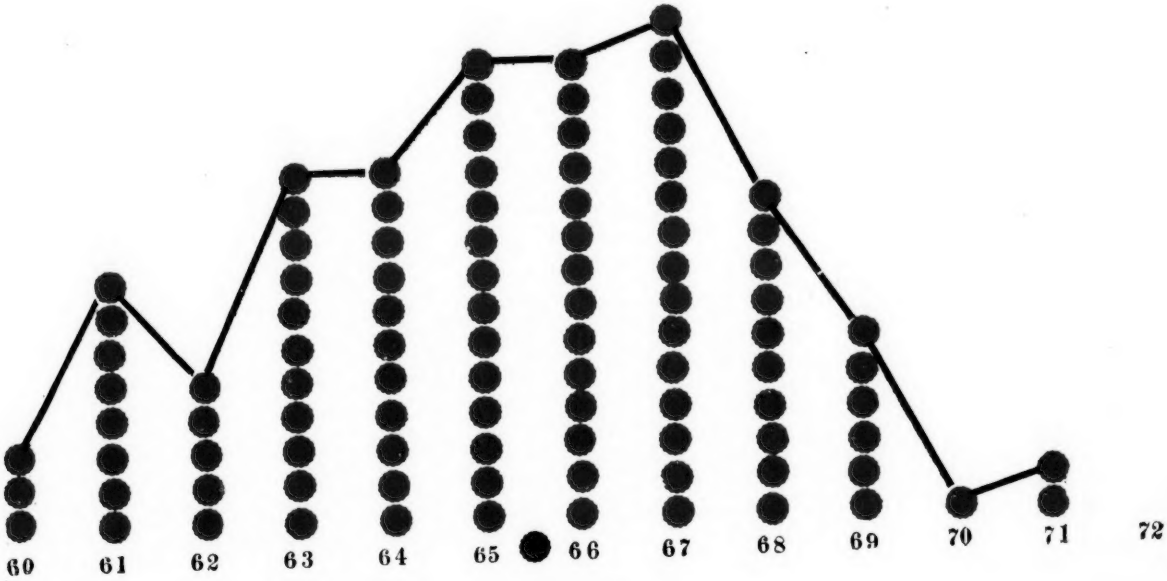
These curves of distribution bring out certain characters that it would be quite impracticable for one to detect by the mere examination of a few representative fish, and it would be quite possible for one to decide by such curves which of two baskets of fish come from Woods Hole and which from Waquoit, even though the fish bore no other mark than that provided by nature.

The practical application of this principle is as follows: If it proposed to test the result of re-stocking a locality in which a species of fish has become reduced in numbers, it is necessary to first determine the "curve of distribution" from fish native to the locality. This curve may be based on any measurable character, such as the number of fin-rays, the number of scale-rows, or the number of vertabrae. When this has been done, it is then necessary to determine the "curve of distribution" for the same structural character of fishes of the same species, but abundantly found in another locality, from which locality the "brood fish" are to be taken. After the "planted fish" have had time to mature, new curves should be plotted for the first locality. If these curves are practically the same as those originally made, it is reasonnable to conclude that re-stocking has been ineffectual. If, however, the curve of the original locality becomes modified and approaches that of the second locality (that is, the locality from which the brood fish were taken), it is reasonable to conclude that the influence of the fish new to the locality has been felt, and that the re-stocking has been effectual.

The following objections may be raised to the method just given:

1. It may be that due to the small number of specimens, the curve represented on the first diagram is not really characteristic of the Woods Hole specimens.—To test this source of possible error, three separate groups of flatfish were examined, all from the same locality, and each group containing one hundred speciments. The resulting curves were strikingly alike. (Of course it would be much more satisfactory to base all the curves on the enumeration of one thousand rather than one hundred specimens, but even one hundred specimens evidently yield fairly definite results, though, to be sure, the curves are somewhat uneven.)

2. It may be that the variation in the position of the curves on the two diagrams is a result of age—i. e., the fishes from Woods Hole average a larger number of fin-rays simply because they are somewhat older. This possible increase on the part of the older specimens, if present, can readily be detected by simply comparing the average number of fin-rays of the younger with the average number of fin-rays of the older fish. Fifty-three young, *less* than ten inches in length, have a mathematical average of 66 dorsal fin-rays; forty-seven older fishes from the same locality, all *over* ten inches in length, average



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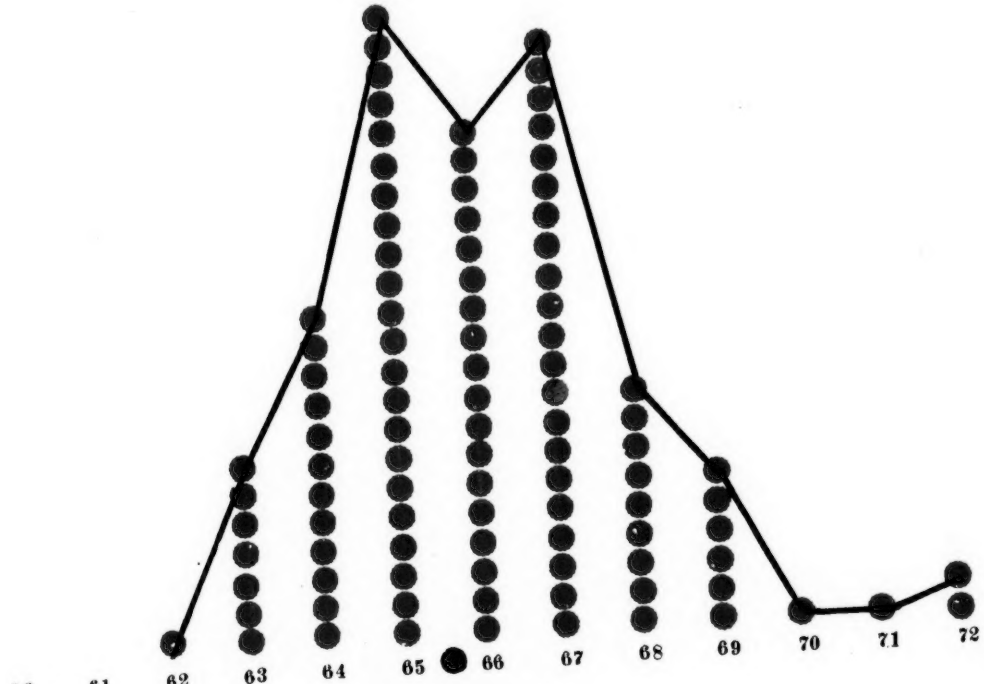


Woods Hole.

practically the same number. The question of age, then, does not enter in as a disturbing element.

3. It may be that the variations tabulated are the result of environmental conditions expressed upon the fry and young; they may be merely acquired characters of questionable hereditary value. In other words, it may be that the fry reared at Woods Hole attain to a larger number of fin-rays than the same fry would possess were they reared at Waquoit. While certain experiments that the writer has made induce him to believe that these variations in the number of dorsal fin-rays are really deep-seated characters and are *not* the result of environmental conditions, it must be remembered that if the variations are admitted to be the result of strange surroundings, the method is not necessarily thereby vitiated, for if it is insisted that certain external influences may affect the fry *after* liberation from the hatchery, and the results of these influences are expressed by a change in the fin-ray formula, it must also be equally true that the much more extreme an unusual environmental conditions imposed upon the still younger organism while *within* the hatchery will also leave their stamp, and the artificially hatched fish will thus present some peculiarity (acquired though it may be) which will be brought out by the plotting of curves of distribution.

Mr. Whitaker: What is your opinion, Prof. Birge, as to these structural differences spoken of and the ideas advanced in this paper upon that point?

Prof. Birge: It seems to me there is a chance for very valuable work just in this connection. The flatfish hav an enormous number of fin rays, so great a number that we should naturally expect the kind of local variation which the professor finds. Whether this would be true of the whitefish or lake trout or any of the fish of the Great Lakes, I dont' know, but it seems to me that there is a point the fish culturists might well investigate. I haven't very much doubt that somewhere or other there could be found some such difference between the Lake Michigan lake trout and the Lake Superior lake trout. If, as Mr. Nevin says, we have to go to raising Lake Michigan trout eggs and planting them in Lake Superior, it would be quite possible to determine whether the fish as they are caught were the result of planting or the result of natural increase.

It is almost always true with any species of animals from different localities, certainly when they are widely separated, that

though when you take two or three of them and look at them you may not discover any particular difference, yet if you take enough of them from various localities the characteristics will come out in the average.

Mr. Whitaker: I have never given any attention to those differences, but I had supposed from my familiarity with fish and from reading Dr. Henshall's Book on the Black Bass, that one of the distinguishing differences between the large and small-mouthed bass was the number of fin rays in the dorsal fins, and the number of fin rays in the dorsal was of a constant character and that the number of rays was always the same in each individual.

Prof. Birge: The number of fin rays is characteristic for any species of fish, but the number is not absolutely constant. The spinous dorsal fin rays in the black bass are, I believe, 11 or 12. Where the number is so small you would expect to find little variation, although it might be possible that in the black bass from one locality you would find a larger proportion with, say 11 rays, than you would in those from another lake. If that should be found, it would be an instance of the same sort of variation that Prof. Bumpus finds in flatfish.

Mr. Clark: I would like to ask the professor why there should be this difference, why Dr. Bumpus should probably come to this conclusion that these were artificially hatched eggs.

Prof. Birge: He does not come to that conclusion.

Mr. Clark: In a sense he infers it.

Prof. Birge: No, you don't quite get his idea. Prof. Bumpus has simply taken these fish from two different localities as an illustration of what might be done to determine whether given fish are the result of planting or of natural increase. The point is this: Suppose that you breed from the fish at Wood's Hole and plant the young along the coast. Later you study the number of fin rays in the flatfish from the places where you have planted the fry. The average number of fin rays would show you whether the fish were the natural product of the locality or the result of planting.

Mr. Stranahan: I would like to add as to the general subject as to the shape of fishes that we have in northern Ohio two distinct forms of small-mouth black bass, I perhaps might say varieties, although our more scientific friends might consider even "varieties" too strong a word.

The ones in the rivers above the dams are longer, slimmer and more fusiform; those in the lake, which never enter the rivers, are shorter, broader, and more compressed.

There is also an intermediate between the two, partaking of the characteristics of both. These come from the lake into the mouths of the rivers and up to the first dam to feed and to spawn in the spring and to feed in the fall, and it is not improbable that they also hibernate there, as I have caught them there late in the fall on a warm day, after hard freezing weather had set in.

The pike-perch of Sandusky Bay is easily distinguished from its species taken about the islands in the main lake, being more fusiform and longer for a given weight besides being of a decided yellow cast, while the lake fish is broader, more compressed and the yellow shades almost or quite wanting. It may be interesting to state, in passing, that the pike-perch taken in the Lake of the Woods in Canada—many of which are brought to Sandusky to be marketed—cannot be told from those taken in Sandusky Bay by the commercial fishermen who are handling them constantly.

These differences are persistent to a well nigh universal degree, and perhaps might be worked out in the more minute structural lines as to fin rays, scales, etc.

Prof. Birge: Yes, they could be; the question would at once arise whether these differences are sufficiently permanent. For instance, you brought stream black bass into a lake, will they keep the stream form or assume the lake form?

Mr. Stranahan: You may stock a stream ever so well with black bass from Lake Erie and if they can possibly get back to the lake, they will get there. We know that by experience; the ones planted from Sandusky Bay planted in Chagrin river didn't show up at all. I should expect to see that hereditary disposition show up for one or two generations.

Prof. Birge: How is it about stocking lakes with stream fish?

Mr. Stranahan: They would go to the streams if they could get there; their hereditary disposition doubtless would carry them into the streams.

Prof. Birge: The professor has used for practical purposes, one of the newer methods in biology. One thing that biologists have been doing recently has been to get at the average of structure and to state the amount of variation from the average. They have begun to measure in a large number of individuals

the main structural characteristics, which are capable of measurement, so that they can tell in a moment what the average is and how the animals distribute themselves within the range of variation. There is often a great difference in this distribution, so that while the average may be very nearly the same, and the amount of variation may be very nearly the same, the curves may be very different as in some of these diagrams. It seems to me that there is a point of very great practical value. I don't think very much of your matters of general form in connection with black bass and the shape of black bass. I think that would be too variable and too indefinite.

Mr. Clark: It is a fact that in the Great Lakes we can pick out fish that we are almost positive were artificially hatched, from the looks of the fish. Now, for instance, and I think the superintendents here will bear me out, we find in upper Lake Michigan and Lake Superior, fish that we at once say, is a Lake Erie whitefish.

Mr. Whitaker: There is no doubt about it and it has just the appearance of the Lake Erie whitefish as to its form, and general color. We, of course, as practical fish culturists, have not entered into this question of structural differences that you speak of. We distinguish the difference by the form and color of the fish.

Mr. Nevin: It is the same thing between the Lake Michigan and Lake Superior fish.

Mr. Whitaker: The work of the Michigan Fish Commissioners is a pretty fair practical test in the determination of that question. Our commission gets its supply of ova largely from Lake Erie whitefish. These fish are distributed by us all through the other lakes, and we frequently receive reports from fishermen which show there is a variation in form and color between the planted and indigenous whitefish which distinguishes them. They say "these are Lake Erie whitefish because they are different from ours;" that is, the difference is so marked as to be noticeable.

Mr. Nevin: In 1889 we planted about 10,000,000 whitefish in Lake Superior; in the last three years they have been getting them by tons and tons. Fishermen will go out and catch them in great quantities.

Mr. Stranahan: Mr. J. N. Dewey tells me that he catches fish at West Sister Island that are very different from the Lake

Erie fish. He says they are so different and distinct that the fishermen can readily pick them out. Fry of the black fin whitefish were planted there some ten years ago.

Prof. Birge: The counting of the number of fin rays is no very enormous job.

Mr. Stranahan: Don't they have to dissect them?

Prof. Birge: No, simply spread out the fins and count the rays.

Mr. Bower: It seems to me that this discussion has developed the fact that we have too little faith in the fish we turn out from hatcheries. When young fish are returned to indigenous waters I challenge anybody to give a reason why there should not be as good results as from those hatched in the natural way. When we can take shad from hatcheries, transport them across the continent, and plant them into waters where the species had never existed, then contemplate the remarkable results that have followed, our faith in the work of planting fry rests on the solid foundation of proof of results. We didn't need to identify the first adult shad that appeared in the bays and rivers of the Pacific coast, nor was it necessary to identify one trout in hundreds of streams in Michigan. The simple presence of these fish was proof indisputable that they grew from planted fry. Should not our faith in the work of planting fry in strictly native waters be strengthened rather than weakened, in the face of what planting in non-native waters has accomplished? And should we not feel entirely confident that as large a percentage of fry so planted survive to maturity as from the wild fry, whether we shall ever be able to identify one from the other or not?

Mr. Whitaker: The point made by Mr. Bower has been proven repeatedly. I don't think you need to argue to fish culturists that artificial propagation has not been a striking success in the stocking of waters. The great success that fish culturists gain by their methods is gained by the isolation of the ova from natural enemies until the eggs have hatched. Up to that point you have minimized the loss. We have in Michigan the finest river in the world for brook trout fishing and that stream was first stocked with trout in 1879. I intended to have brought some data I have as to the immense number of trout taken from it in one year, given me by Salling, Hansen & Co., of Grayling, Mich. They arranged with the boatmen on that stream to give

them an estimate of the number of fish taken on the stream, during the season. I cannot state the number because I don't remember, but it was perfectly marvelous. The river contained nothing but grayling up to 1879, when our commission began stocking it with trout, and the results of that work establish beyond doubt the efficacy of artificial propagation. I wish to endorse what Mr. Bower said regarding the stocking of Pacific slope streams with shad and its success. There is an interesting thing to fish commissioners in connection with that work. Col. McDonald took occasion at one time to write a monograph on that work which was very interesting. He stated that the Japan current sets in towards the coast of California, and because of the temperature of that stream instead of the shad only returning to the rivers where planted they have distributed themselves northward in tidal streams for hundreds of miles. They have stocked those waters so thoroughly, from the small plants made, that Mr. Blackford when in San Francisco a few years ago sent a dispatch to this society at a meeting held in New York, stating that the number of shad on the market in San Francisco was so great that they had to avoid glutting the market by regulating the catch, and that the shad were larger in size and greater in quantity and cheaper in price than in the New York market. It is the same with the striped bass and neither one of these fish were indigenous to the streams of the Pacific coast, but were the results of planting.

Mr. Clark: Perhaps the members of the society will think that after a life of thirty years in practical fish culture, I am losing faith in the work of the fish culturist, if I say nothing at this time. I want to put myself right and straight on the matter. I am just as strong in the faith as I ever was. Speaking of the work of transplanting shad from the Atlantic to the Pacific coast, I will say the United States Fish Commission made these plants—and I don't like to say that I was one of them, but I was. Outside one small plant, the plants of shad carried to the Pacific coast were carried there under my direction; that is, I had charge of the trips up to the time that the fish were sold in the San Francisco market for five cents apiece. I carried all the fish to the Sacramento River except five thousand; therefore, I ought not to lose faith in fish culture.

Mr. Whitaker: Do you remember about what the aggregate of the plants of shad was?

Mr. Clark: Six hundred and forty thousand made in three

different plants, outside the plant made by Mr. Greene. In 1876 I took through, with Dr. Bean as my assistant, 200,000; in 1877 I took through 200,000, in 1878 I took through 200,000. If the gentlemen here had seen Dr. Bean and myself trying to take through the first 200,000 they would have thought we were lunatics. The report was that it was not possible to transport them in a baggage car in cans unless you could keep the temperature above 72. In going over the mountain in summer time in June, we found pretty cold weather in the night time. There were snow storms and we built a fire in the stove. We could not warm up the water; it kept going up and up and at last we took our coats off and rolled up our sleeves and ran our arms down into the water and tried to warm the water. We pulled off our shoes and stockings and put our legs in and tried to warm the water. It ran down and down, but we succeeded in carrying through to San Francisco a lot of the finest shad I ever saw.

Mr. Bower: I wouldn't have it understood for a moment that I belittle the kind of work spoken of by Prof. Bumpus, but what I do want to say is that I don't believe in the necessity and don't understand exactly why fish culturists should need to have documents of that kind to bolster up their faith in fish culture. We don't need to have our fish identified before we are satisfied that we are getting good results.

Prof. Birge: It seems to me that Mr. Bower has understood this paper differently from what Prof. Bumpus intended it should be understood. I don't understand that we are arguing that the work of planting fish is not practical, but there are a great many people, and gentlemen of intelligence, who say, how do you know when you put fish in Lake Erie, for instance, what becomes of them? How do you know they have come back again, that they don't go away, or how the fish increase, or that these are not the fish that came in from the natural breeding grounds? You can answer the question and perhaps prove it and no doubt you can, in many cases, convince the man you are talking to that you are increasing the fisheries in that manner, yet if you can have a definite and positve answer it would be better. The more positive proof you have, it seems to me, the better.

Mr. Spencley: It seems to me there is a great deal of difference between faith and proof. Mr. Bowers says he has a great deal of faith, that is all very true; I don't believe any person present at this meeting has any doubt about the success of fish culture, but as Prof. Birge has said, sometimes you have got to prove it.

We have had some difficulty in Wisconsin. We have been telling people that we have been planting whitefish and that they have been increasing in numbers; some of these people will say, I don't believe you, you haven't got anything to prove it. You cannot convince the average fisherman against his own will. Several years ago Mr. Nevin took inland fish and put them in Lake Superior; they produced an entirely different kind of fish, so that the fishermen then had to admit it. There was the proof and the fishermen of Lake Superior now admit that fish culture is a success. I think this paper is in that direction, it is to get proof so that it will satisfy everybody and will give them the proof that fish culture is a success. I think he has tried to demonstrate in another way that it can be shown by proof that the artificial propagation of fish is a success. It is simply in the same line as these experiments with the Wisconsin fish.

Mr. Whitaker: If there is no further discussion on this paper I beg the indulgence of the society for a few moments. We have with us a citizen of Omaha who is seeking information about fish. He is making some experiments which he desires to have a little advice upon. He proposes to do some work in fish culture in connection with artesian water. He is the Surveyor of Customs of this port. I have the pleasure of introducing to the society Dr. Geo. L. Miller, of Omaha.

Dr. Miller: Gentlemen: This is an agreeable surprise to me. I saw the notice of your coming among us and I took an immediate, personal and selfish interest in it as well as a public one. It is indeed a very great courtesy that my friend suggests that I should say a word in a convention of this importance, devoted to prepared papers and on fish culture.

I take advantage of the opportunity to say that I am, from my nativity and the associations of my boyhood, a lover of fish. Where this younger man (referring to Secretary Whitaker) first saw the sunlight and with the streams with which he was familiar, I have been familiar in a long and active life, the Northern Adirondacks. We were both natives of New York, you of Lewis and I of Oneida. I have resided here since this was a white settlement, for more than forty years. I came in here to hear suggestions from you on a subject in which I am interested. Mr. Ravenel, of the United States Fish Commission, has been very polite in making suggestions to me about a lake which I have of forty acres. I began without any scientific knowledge to put in breeders, and through the courtesy of Mr. May I put in some

young trout and some old ones. I had hopes I could exclude all other fish, but to my utter astonishment the selections were not properly made, and I find I have all sorts of fish, peculiar and indigenous to the country. Mr. Ravenel told me that the rainbow would probably live in a temperature of 60, but for the reason that the water would become warm very soon after coming out of the artesian well, which is about a thousand feet away, I didn't venture to risk it. What I have come here to find out is, whether I could risk putting the rainbow in that water that is fed by water of 60 degrees temperature?

I would like to know if bass are cannibals. As I say, it is a purely selfish interest on my part, outside of a public one. I have raised bass from breeding to a pound and a half and a pound and three-quarters, and I have had two or three thousand fish taken out of there by fishermen.

I want to know another thing, if some gentleman will give me the information, whether bass are in any danger from bullheads and carp? I also want to know whether I am in danger of overstocking this forty acres of water which has neither inlet or outlet. I want to know what proportion I can expect to raise from breeding, and whether I am in danger of overstocking this place and making it an offensive place.

Mr. Peabody: We have a number of gentlemen who can give you a great deal of information. You will find out a great deal of that information from books written by Dr. Henshall.

Mr. Whitaker: I think the society is to be congratulated in having just such questions proposed. It touches the practical side of fish culture. I felt when I introduced the doctor, that the society would be very glad to hear from him. He has suggested enough to warrant us in giving him some information, if we can. I think there are those here who can give the information he asks for. I want to say that I had prepared a paper touching on this very point, but I find I have left it at home. It touched on the question of overstocking waters; it touched on the question of the proper places in which to plant fish; it touched on the question of the attempt to exterminate native species from lakes by netting. Very many people feel that they would like to know whether they can take a given water and stock it ad infinitum and make a success of it. I suppose it is a pretty well established fact that nature sets up a pretty correct natural balance between varieties of fish in all waters. Many of the states have beautiful lakes to which people resort for

summer homes. Those lakes may have been naturally stocked with black bass, but the persistent fishing of a dozen or more anglers for four or five months in each year, with the spearing that goes on at other times, has in course of time depleted the waters of bass. The next thing that we as commissioners hear is an application from the denizens about some lake for a permit to net out the suckers, which they say have grown in numbers enormously, and they believe the suckers are killing the bass. This is not so. The bass is a fighter who will maintain himself against any other fish of even greater size. In no case should the attempt be made to destroy the sucker, which is prime food for the bass, or the carp, which is also fine food for the bass. If I had a private water in which I wanted to raise bass, I would see to it that a certain number of carp were put in there as food for the better fish, and they wouldn't hurt at all if you can keep them in control.

Again, we hear someone say, I have a magnificent stream, I want 50,000 or 150,000! brook trout put in that stream at its source. That is the poorest place that could be selected. Plant them away from the source; put them in ponds made along the stream. You there give opportunity to the insects to deposit their eggs, which are fish food. In time you have natural food that will to a great extent support fish life. You may overstock a stream or lake, and if you do so, in time you will have a generation of runts. You must avoid that. If you do it your fish will be undersized, and that is the case with many clubs who have overstocked their waters in their anxiety to increase their stock.

Dr. Miller: Would you leave the carp in the water?

Mr. Whitaker: You cannot get them out after they are once in.

Dr. Miller: Would you keep them reduced?

Mr. Whitaker: Yes, and I would reduce them by putting in enough bass to keep them down.

Dr. Miller: How about the bass eating one another?

Mr. Whitaker: The bass is supposed to be one of the very few fish that takes care of its young. They select a place for nesting and lay their eggs, and guard them from their enemies.

Dr. Miller: I think that Mr. Henshall states that after they leave their nests they eat each other.

Mr. Whitaker: Large fish will eat small ones under all circumstances if they get a chance. The fish culturist learns that in his practical work. You have got to separate fish of different ages as well as you can, to prevent it, when held in ponds.

Mr. Stranahan: The black bass won't prey on their kind if they have an abundance of other food. I believe it is of more importance to you, Dr. Miller, with your area of water, to see to crossing your fish with new stock than it is to look after the carp. I have had some experience with much larger ponds than yours where the stock has become diminutive through inbreeding. I should say it would be the best thing to introduce every year a new stock of bass; if you don't, you will get a diminutive race.

Mr. Peabody: There is a club in Indiana that has taken up the subject of producing bass artificially. They have two artificial ponds in which they keep their bass, and another in which they carry on the hatching. In the small one they keep the bass until they get large enough to be active; then the club takes all the larger ones and puts them out. They have a drain in the center of this pond by which they can draw the water all off. Then can go into it and take out all the fish. They have met with such success that they have their larger ponds amply stocked. They do this all in an artificial way.

Dr. Miller: I wish to state for the information of the gentlemen that Mr. May, the honorable president of your convention, is the gentleman who started me in my enterprise, with this result, that this year out of my lake there have been caught, I suppose, two or three thousand bass by hook and line. This spring I put in twenty breeders and I don't know how many young bass there are, but the lake seems to be alive with bass. I came here this morning without an invitation. I felt that I was somewhat at home with fish men. I came in to see about some things that have been answered by my friend from Michigan—originally from New York. I was told that I was in danger of overstocking this lake. I thank you, gentlemen, for your kindness. I can now go home with a good deal of light upon the subject I wanted to be enlightened upon.

President May: The next paper in order is a paper by Mr. O'Brien.

Mr. O'Brien then read the following paper:

LARGE-MOUTHED BLACK BASS.

Methods of Hatching and Rearing.

A great deal has been said and written, at former meetings of this society, on bass culture, by persons of much greater ability than myself, therefore do not expect an elaborate essay from me. But as we departed somewhat from the usual method of handling our bass spawners at the Nebraska hatcheries the past season, possibly my experiments and the results obtained will prove of interest to those engaged in this branch of fish culture.

Our main spawning pond has a surface area of about one acre and, with the exception of the kettle, or drainage point, averages about two feet in depth; bottom being both mud and sand.

Previous to the spring of 1896 it had been the custom to place the spawners in the pond as soon as the ice melted off, together with a large number of chubs and shiners to serve as food and pay no more attention to them until the pond was drawn off in the fall to remove whatever young bass there might be. This haphazard manner of propagation, of course, resulted in rather indifferent success.

In the spring of 1896 I used gravel spawning beds with brush shelter and removed a large number of the fry to another pond when about a month old and fed ground crayfish with considerable success.

The spawning season for bass, in our ponds, extends usually over a period of about six weeks and I noticed when we transferred the fry there was a great difference in the size of some as compared with others and after the fry was moved I noticed that although I fed an abundance of ground crayfish, and there was considerable insect life in the pond, the larger fry preyed on the smaller ones continually, diminishing the number to a considerable extent.

In the spring of 1897 I decided to change the method of handling the spawners entirely; instead of transferring them from the winter pond to the spawning pond when the ice melted off, we placed the spawners in a pond that had previously been used for trout where temperature was about 55 degrees.

We then drew off the water in the spawning pond about the 1st of May and allowed it to remain dry for ten days. We then placed eight wagonloads of mixed fine and coarse gravel on the bottom of shallow portions of the pond, in spots or beds about eight feet square and about two inches deep. We also put in twelve spawning boxes made of wood three feet square with

sides three inches high and filled with gravel. The pond was then filled with water and willow brush laid in V-shape, the butt ends of the brush being crossed at the pointed end of the V, being placed around each spawning bed, forming a perfect enclosure.

Willow brush with the butt ends sharpened and stuck in the bottom of the pond was also placed around the spawning boxes to afford seclusion for the spawners.

May 29th the spawners, 42 in all, about an equal number of males and females, were transferred to the spawning pond; the temperature in the pond being about 66 degrees, a change of 11 degrees from the pond from which they were transferred; the spawners were put in near the inflow pipe and the change of temperature did not seem to affect them in the least, but as I had expected, it caused the ova to ripen rapidly and within twenty-four hours they began to pair and spawn, and in nine days from the time they were placed in the pond the last pair had spawned; out of the whole number only two pair used the spawning boxes and one pair spawned in open water on fine sand.

The eggs hatched out in eight days and when the fry were about a month old I transferred what I estimated at 20,000 to an adjoining pond, collecting them with a one-eighth inch mesh common sense minnow net, the most of them being taken about sundown around the inflow pipe.

In the same pond with the fry I placed a large number of eyed carp eggs, laid on moss, the carp when hatched to serve as food for the young bass. This experiment proved a failure, for within a month the carp had grown so rapidly that they were as large as the bass and were destroying all insect life and making the water very muddy.

Wooden boxes two feet square with slat sides one-half inch apart and supported by stakes driven in the bottom of the pond were then placed at different points in the pond and ground crayfish placed in these fed for the balance of the season, but the carp kept the water so roily that the bass did not seem to thrive and when the pond was drawn off in September less than fifteen per cent. of the number placed in the pond were found.

The original spawning pond was well stocked with chubs and shiners, which spawned about the same time as the bass. About the 1st of August I partitioned off about one-third of this pond near the inflow pipe with one-inch mesh galvanized wire fencing, supported by stakes driven in the bottom of the pond and extending ten inches above the surface of the water, this fence being put in to allow the young bass to feed on the minnow fry

undisturbed by the parent bass. The bass in this pond thrived beyond my expectations and when the water was drawn off in October I removed over 33,000 young bass of an almost uniform length of three inches, not to exceed 30 oversized fish being found among the whole number.

The uniformity in size I attributed entirely to the fact that the fry were all hatched at practically the same time and I believe that if bass spawners were held in water of a low temperature until about the 1st of June and then placed in spawning ponds where the water is several degrees warmer, so as to ripen the ova rapidly and thereby shorten the spawning period, that much of the loss and annoyance caused by oversized fry would be avoided.

Although the experiment in feeding the carp fry to the young bass in the pond proved a failure, yet I am convinced it would be possible to keep carp spawners in water of a low temperature to prevent them from spawning until late in the season, allowing a few pair to spawn at intervals as needed; this, I believe, would prove a cheap and easy method of feeding bass fry in troughs or small ponds where the number of carp fed could be completely controlled by the attendants.

Mr. Stranahan: With reference to this matter, I will say that experiments have been made in France, also in this country by the United States Fish Commission in Washington, to retard the growth of carp. It has been found very successful. Mr. Ravenel told me that the results were very gratifying by withdrawing the food.

Mr. Clark: From Mr. O'Brien's paper I see that he is an advocate of the partial rearing of fish, and that brings us back to the old question that Mr. Whitaker, Mr. Mather and myself fought over so many years ago; the question of yearlings. I think, if I am not mistaken, they dubbed me the "Father of the Yearling." I will say I don't want to bring that question up now, but I am still an advocate of it, but not for bass. If the gentlemen that have been raising bass will take the pains to examine them minutely with the microscope they will find that a young bass one week old is as mature a fish as at five years old. For that reason I am an advocate of planting the fry of the bass. I think when it is thoroughly investigated it will be found better to plant the young bass. I want to put myself on record as an advocate of planting bass fry. If you plant them broadcast in lakes and rivers they can spread out more. It is a more difficult thing to find artificial food for young bass than for other fish.

Mr. Oberfelder: As far as the United States Commission is concerned, I presume it is all right to deliver fry, but when the people who pay for this work are sent the fry they don't think they are getting any fish. The Nebraska Fish Commission are trying to deliver pike six months old; I think the people throughout the State would be better satisfied with the delivery of such fish to them than the fry. They might not from the standpoint of the United States Commission. I know the commisisoner of Wyoming told me that they sent trout last year in cans, saying "there is 5,000 trout in a can," but those who received them said it was the same old fish story; we counted them and found there were but 850. After this they say we want more yearlings and no more fry.

Mr. Whitaker: I don't suppose there is any way by which you can guard against misrepresentation as to the number of fish that are put in cans. I think it is poor policy on the part of a board, and I think they will find that misrepresentations of that kind must ultimately come back to them injuriously. It is not policy, if you want to put in on the ground of policy. It is not honesty, if you put it on the ground of honesty.

So far as not getting results from the distribution of the fry is concerned, that may be as stated in the State of which the gentleman speaks, but it is not so in Michigan. The great and successful work of stocking there has come solely from plants of fry. There is this to be said, in my opinion, that notwithstanding the fact that the planting of fingerling and yearling fish has been advocated in this country by some for ten or fifteen years, the planting of fingerling fish has not made perceptible headway anywhere and the large work of distribution is still being done with fry.

Mr. Clark: And always will be.

Mr. O'Brien: I don't wish to be understood as advocating the planting of fingerling or yearling fish. I just merely mentioned the fact that we are rearing our bass to an age of six months. It is not done because we thought that fingerlings or yearlings were more successful, it was more because we thought we could transport them with greater safety at the age of six months. That is the reason I should put out the bass in the fall. We have hot weather in June and July, and we are not as well fixed to carry fish as the United States Fish Commission.

Mr. Clark: I don't wish to prolong this discussion, but I want the members of this society to understand the point. I

don't care to bring in the yearling question, but the point is, that the black bass is a fish that should not be held and reared, because it is not necessary; because at the end of a week or two weeks they are just as mature as they ever will be.

Mr. Bower: You mean in appearance.

Mr. Clark: Yes, just as well able to take care of themselves as they will be in a year.

Mr. Oberfelder: How about pike? Do you think a pike a week old is as good as one six months old?

Mr. Clark: I have had no experience in the rearing of pike.

Mr. Peabody: I understand you are in favor of fingerlings and yearlings as to trout.

Mr. Clark: I will say I stand just where I did ten or fifteen years ago. In answer to what Mr. Whitaker said and he perhaps didn't wish to be understood just exactly as it sounded, that the yearling theory has not progressed, I wish to say that arises from the fact we cannot raise enough. We can only keep two or three hundred thousand at any station. There is no station in the country large enough to raise a million yearlings. The point is to raise what you can, and as to the balance distribute fry.

Mr. Nevin: Do you mean that in relation to lake trout?

Mr. Clark: Yes, I do.

Mr. Peabody: I am glad to hear you say that. Last winter I talked with the New York people and they are strongly in favor of fingerlings.

Mr. Whitaker: There is no probability, so far as the results are concerned, if you will watch them for the next ten years, that you will find any great increase in their output of fingerling trout. It is impossible, with the multitude of streams we have, taking the great comparative cost of planting fingerlings, to stock the streams of this country with fingerlings.

Mr. Stranahan then read his paper, which follows:

THE MICROSCOPE AS PRACTICALLY APPLIED TO FISH CULTURE.

Prefatory to this paper the writer would say that no one with ordinary intelligence should hesitate to make use of the microscope in fish culture because of any fear that he may not be able to master it.

It is very simple and by the perusal of any one of the many good books of instruction on the use of the instrument, and a little practice, its mastery will come to you with surprising rapidity, and your interest will goad you on until you will find your back and eyes aching, and glancing at your watch, you will dash off for your dinner, conning over some good story on the way to tell your wife as to what made you late.

The most important work of the microscope in practical fish culture is, doubtless, to determine the condition of eggs soon after they are taken so as to remedy early any errors of the spawn-taker which may exist and thus save unnecessary loss.

In examining eggs under the microscope I use a cell that holds about a certain number of eggs, as for instance, in the case of the whitefish my cell holds twenty eggs in a row and five rows deep, making in round numbers 100 eggs, although eggs vary so much in size that this is not absolute.

In making an examination the eggs which are impregnated, unimpregnated and those with ruptured yelks are so easily detected, one from the other, that the cell may be moved under the microscope as fast as you can count.

It is the practice of the writer to examine whitefish and cisco eggs twenty-four hours after they are taken, when segmentation is at its most distinct period. The disc of the impregnated egg will then be found divided into some fifteen or twenty cells, nicely rounded into nodules looking under a half-inch objective as large as kernels of corn. The disc of the unimpregnated egg will be an almost perfect hemisphere and will present a much clearer appearance than the impregnated one. The eggs with ruptured yelks will present a varied appearance. Generally the albumen will be in a layer at the bottom, the oil globules at the top and the disc, much distorted and out of all semblance of the normal, floating between the two. There is another class of valueless eggs, those containing no germinal disc at all, but they constitute a very small per cent., and as, of course, no amount of care on the part of the spawn-taker could put life into these, they need not be taken into account at all.

Thus it will be seen, the eggs at the station can be examined each day, each lot separately, and a record of the work of each and every spawn-taker kept, his errors corrected or the man discharged, and by going over your tables resulting from this work, when you are about to engage your spawn-takers for a season, you can see at a glance who are your best men, weed out the poorer ones and greatly improve your spawn-taking force. Of

all occupations, a careless, negligent, dull spawn-taker is the one to be avoided. He should be intelligent, progressive, obedient to orders and as such, should be paid well for his services and retained from year to year.

About seventy-five spawn-takers are employed at the Put-in-Bay station each fall, and it will be apparent to the most casual observer that this plan of examining eggs must result in the securing of a much larger number of good eggs than would otherwise be the case.

The great advantage of the microscope is that you can determine in twenty-four hours whether your eggs are good or not and apply the remedy, while without it, especially in the case of unimpregnated eggs, you have to wait until the season is nearly over before you know the result, and in the meantime you have, perhaps, lost millions of eggs which should have been saved. The writer frequently uses the telegraph in calling delinquent spawn-takers to task and believes that it has paid well on the investment.

Aside from examining eggs to determine their quality, the microscope can be made of use almost daily while eggs and fry are in the house. Many little emergencies arise when you wish to make a closer examination of eggs or fry than you can make with the unaided eye, and it soon becomes a second nature to resort to the microscope.

To illustrate: At the Put-in-Bay station one morning last April, it was discovered that the pike-perch eggs were so light in the jars that it was difficult to keep them from flowing out, although the water had been shut down to a considerable extent. The microscope revealed the fact that colonies of infusoria—mainly the species Carchesium, with a few Vorticella—were so common that it was difficult to find an egg without one or more. The eggs were thoroughly feathered, thus breaking off the slender stems by which the animals were attached to the eggs, when they worked as well as ever and no harm was done further than that incident to the handling of this very tender egg. I will state, incidentally, that this phenomenon had never occurred before at the Put-in-Bay station and I have never heard of it elsewhere.

As is well known to fish culturists, there is a small loss among all kinds of fish eggs after the embryo has formed, what is called in ordinary hatchery parlance "deadeyed eggs." The microscope will be found convenient in studying the cause of this loss. In the whitefish eggs examined by the writer the past season it

was found that about 30 per cent. of this loss was occasioned by insufficient food supply, that is, the yelk sack being undersize, the albumen would become absorbed when the embryo would starve to death. This loss goes on from the early formation of the embryos up to the time of hatching, those with the smaller sacks dying first and the others later on.

Malformation causes about 20 per cent. of the loss, beginning early where the embryo is very poorly organized, perhaps having merely the semblance of an organization, with the abnormal brain and a rudimental spinal column and yet with a heart and a system of blood vessels. The eyes in these more erratic forms are usually wanting, and if present are very imperfect, these organs being among the first to show malformation, while the auditory apparatus is among the most perfect.

About eight or nine per cent. of this loss is caused by ruptured yelk sacks, ruptured blood vessels and aneurisms.

With about 40 per cent. of this loss the writer was unable to arrive at the cause. His work was all done in gross, not having a microtome or other appliances for making sections, and not being sufficiently versed in the work to have made use of them if he had been thus supplied. It is probable that one well versed in the various sciences called into action in this work and with better appliances could determine the cause of death in the greater portion of this remaining 40 per cent.

The writer has come to the conclusion that, as in the higher forms, nearly all this loss is the natural weeding out of the more weakly individuals, through that inexorable law which provides for the survival of the fittest, and it therefore follows, if this be true, that no amount of care on the part of the fish culturist can do more than cut this loss down in a small degree. It is probable that care in taking and handling the eggs would reduce the number of malformations and ruptured yelk sacks to some extent, but in the main the death of eyed eggs results from natural causes, which no amount of care on the part of the fish culturist can prevent.

The writer would recommend that fish culturists use the camera in connection with the microscope and thus place the results of their labors in a more permanent form.

With a reasonably good microscope and any camera which has facilities for handling dry plates, photo-micrographs can be made by removing all the lenses from the camera, which can be connected with the microscope either perpendicularly or horizontally according to the egg, whether best viewed from side or top.

and some simple appliance arranged for excluding the light at the union, or, if the lenses of the camera are good ones, they may be left in and better results be thus obtained. The writer pursues the latter course with better results than with the former. When the mrcisocope is well focused the camera will be, no matter whether the bellows be drawn out to the fullest extent or short-focused, the only difference being the size of the picture.

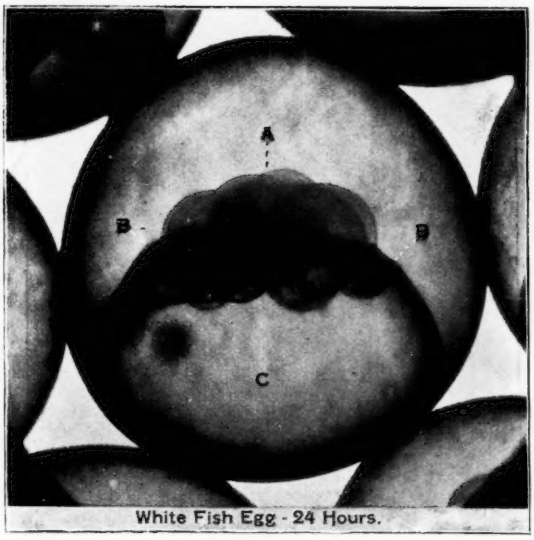
From half a minute with a Welsbach gas burned to five minutes, or a little less with a coal oil lamp will be found within reasonable range for time of exposure but this will have to be determined by individuals by experience.

Quick plates should be used, and Metol developer will be found to be the most effective, giving a wide range, and being especially good where the plate is under-exposed, very likely to be the case where the embryo is sufficiently developed to move in the egg or with fry while alive.

In conclusion, I would say that the making of photo-micrographs is not nearly so difficult as most people suppose and that it can be readily mastered by calling a little perseverance and patience into requisition.

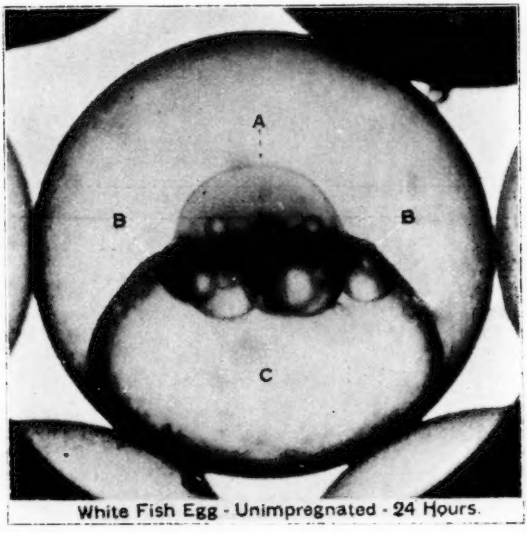
Mr. Whitaker: I want to say a word in connection with this paper, as it seems to me to have great practical value in connection with the stripping of fish. I believe that strippers become ultimately overconfident of their ability and become careless in their work and need just such a correction as this examination by the microscope will give. I think that the percentage of poor ova is due very largely to this overconfidence and poor handling of fish in spawning time. In a manual recently issued by the United States Commission there is an excellent article about the careless handling of fish in spawning operations. It appealed to me to be a very just criticism. It is the rough handling, to a certain extent, that causes the large loss of spawning fish at that time. This use of the microscope as applied by Mr. Stranahan seems to open to the practical fish culturist a very wide field. It is greatly to the credit of Mr. Stranahan that he has taken this work up in the way he has and I imagine in the next few years, if it is pursued by others, a great deal of good will result from its use.

Mr. Nevin: The way we keep track of our strippers is to have our boxes numbered, a number being given each stripper, and we keep track of his eggs; we send notice to the man if his eggs are poor, and if he does not improve we drop him.



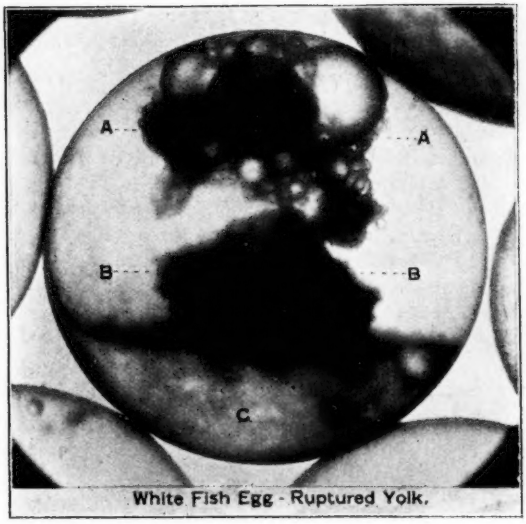
IMPREGNATED WHITEFISH EGG, 24 HOURS AFTER TAKING.

A - Germinal Disc, showing Segmentation.
B - Layer of Oil Globules.
C—Yolk Sac. (Magnified 21 diameters.)



UNIMPREGNATED WHITEFISH EGG, 24 HOURS AFTER TAKING.

A—Germinal Disc, Segmentation not having taken place.
B—Layer of Oil Globules.
C—Yolk Sac. (Magnified 21 diameters.)



WHITEFISH EGG, 24 HOURS AFTER TAKING, SHOWING YOLK SAC RUPTURED BY CARELESS SPAWNTAKER.

A—Oil Globules.
B—Disrupted Germinal Disc.
C—Layer of Albumen from Ruptured Yolk.

(Magnified 21 diameters.)

Mr. Stranahan: In that case it takes all the way from four or five days to two weeks to determine whether the eggs are fertilized or not, so you may lose by the carelessness of the spawn-taker, a million eggs, while in this way it is determined at once and he is notified by telegraph.

Mr. Bower: I used to be associated with Mr. Stranahan at the Put-in-Bay hatchery when we didn't use the microscope. I am thoroughly convinced that from what he has learned from the use of the microscope, he has got anywhere from 15 to 25 per cent. increase in hatch. That shows that the microscope is of great practical value.

Mr. Clark: I was rather skeptical on the question of the use of the microscope as applied practically, until I visited Put-in-Bay and witnessed its operation. I was instructed to proceed on the same line; I visited Mr. Stranahan's station and Mr. Stranahan showed me how his observations were conducted. I supposed it was going to take him a long time to do it but it did not take more than two minutes before he had figured out what the percentage of loss was and in about five minutes he had the eggs transferred to a photographic plate and in about twenty minutes he showed me the photograph. Any superintendent can do it; it is a very practical thing, especially with whitefish and lake trout eggs. I propose to take up this work, but I didn't get it in time last season to do so.

Mr. Gunckel then read a paper entitled "Fish Culturists," which follows:

THE FISH CULTURIST.

Generally speaking, scientific men, men whose knowledge upon any specific group of objects has been gained by systematic observation, experience, and reasoning, become so absorbed and lost in their work that the public seems to lose interest in them, and they in the public; the latter only appreciating and enthusing when the results have been obtained. The botanist will introduce a new peculiar name, and look serious as he carefully analyzes each sprig, leaf, flower, but the world only cares for what is of personal interest, of pecuniary gain, or of pleasure, and sees only its outward beauty, and praises its rich fragrance, and no one cares whether it comes from the Ladrones or the bottom overflows of the Missouri. So in like manner it can be said of the history of the science of physiology, of chemistry, astronomy, modern electricity, which has harnessed the most potent force of

nature for man's use; and of the other sciences of equal importance, requiring deep thought, experience, and seclusion. But to no science can nature claim a closer alliance than the science of fishes. Its branches leading us nearer to nature and thus closer to humanity. It directly appeals to all the finer senses, and the pursuit of its objects leads us into many pleasant places, among the most beautiful realms of God's earthly kingdom.

As the population of the world increases, the demands upon the land and water resources naturally increase. The buffalo, the deer, the wild pigeon, dozens of other American game, are almost numbered with our animal curiosities, and no one has ever suggested a way to replenish the forests. Once gone, forever gone. But when our streams are robbed of food life, our commercial fishes driven from our shores with certain species now almost extinct, the fish culturist finds no trouble in restocking, and in many instances better than before. The grayling, that most beautiful of all inland fishes, almost extinct, in the fish hatchery department of the Trans-Mississippi Exposition you will see young fry by the thousands perfectly at home and but recently brought into this world by our careful fish culturist, soon to be planted in their native Michigan streams.

Since the first meeting of this society on December 20th, 1870, to the call for the present session, men have earnestly devoted time, study and money in devising ways and means, not only to protect the fishes of common waters, to replenish the depleted inland streams, through natural and artificial processes, but to introduce new species. The salmon rivers of the Pacific slope, the shad rivers of the East, and the whitefish fisheries of the lakes are now so thoroughly under the control of the fish culturist that it but remains for the Government of the United States, and each State individually, to give them the same unlimited authority as are given to other sciences of less importance.

Fish culture has been practiced from very early ages. It appears to have been in use in ancient Egypt, and was followed in China, but it was confined to the propagation and rearing of young fish in artificial ponds, with the view of introducing fish not previously found in the locality, or of increasing the supply of desirable good fishes. We find in the Smithsonian Report, 1880, page 149, the following: "The first honor prize, the gift of the Emperor of Germany, was awarded to Professor Baird, as a personal tribute to one who is regarded in Europe as the first fish culturist in the world." As a result, to-day, salmon and trout

ova sent from Great Britain have been successfully hatched in Australia and New Zealand.

The great problems that the fish culturists had to meet, and to solve, were first, to prohibit wasteful or immoderate fishing, to aid in maintaining a natural supply. It was soon found that the States made no laws to protect that were really good, until the legislators were of the decided opinion that the fish were nearly all gone. When fish, as a nutritious and nourishing food, became more generally appreciated, it was found necessary to resort to the art of fish breeding to increase the supply beyond the natural limits, rapidly enough to meet the necessities of a constantly increasing population.

If our law-makers will carefully examine the fisheries exhibit of expositions, and particularly the present Trans-Mississippi Exposition, now open to the world, in this beautiful Western city, I am sure they will learn many things of great importance, and feel forever friendly toward the fish culturist, and return home convinced of the necessity of furnishing the people with good fish food, something more substantial than the results of political feuds. As near as I could examine the exhibits, with limited time at command, I am glad to say that those with whom rests the honor and responsibility of its careful preparation and complete representation of a fisheries exhibit, should feel proud that their work is so well done and so complete. As near as possible it embraces the greater part of the subject of the preparation of the fishing products, so particularly interesting to our fresh-water people, and the products themselves, including fish culture and scientific study of the matters relating thereto. There is no exhibit so attractive, and retains the American visitor so well, as an exhibit of live fish. There is no other exhibit at the Omaha Exposition where one is compelled to either elbow his way through the crowd or wait patiently his turn, as the fish exhibit. Hence the importance of improving this exhibit whenever and wherever opportunity affords. It's an educator. It proves a most instructive object lesson to all.

International exhibits give a good opportunity to review the work done in different branches of human activity. To the fish culturist it exhibits the results of his work as can be done in no other way, leaving a lasting, profitable impression upon the minds of the public.

It has been said that Europe originated and developed the various methods of carrying on fish culture, but it becomes an industry only in America, and a very important one from the stand-

point of the Government. America within the past few years has done more scientific work, to find out the secret of nature's workings and to bottle Spanish mackerel, than in any year of its history. Limited as may seem the work of the American Fisheries Society, the people owe to the individual members of his Society a debt of gratitude for the efficient work, the complete and thorough knowledge of how to supply the increasing demand of our people for more fish food, the solution of the secret of fish propagation, the adaptation of waters to the various species of fishes transported from one country to another, and so complete will be the work that our inland streams will be stocked with fish from the Philippines and other countries now becoming more familiar to the American people.

It has been said often that fish is the poor man's food, for, unlike any other food product, it may be had for the taking. A fish swimming in the water costs no man labor. In the cold waters of the North there float a hundred barrels of whale oil; covering the ocean's surface off Labrador's rugged coast, dart millions of mackerel. Along the coast of Maine, with its hundreds of inviting inlets and estuaries, waiting the pleasure of the fishermen, float the Atlantic's great variety of food fishes known the world over for their exquisite delicacy and richness of flavor. Farther south lie bushels of oysters, and the Southern waters teem with savory and nutritious food fishes. The fresh water lakes abound in whitefish, pickerel, herrings and other valuable commercial fishes, many of them now the results of the fish culturist.

To the earnest fish culturist it is not always hard work. There are times when he enjoys the fruits of his labor. There are times when the fish culturist feels sad and disheartened because those members of the finny tribe, those who owe to him their existence, fight him. When they passed the fingerling age, the age that always arouses a long discussion, they seem to forget their best friends. In that clear and beautiful Michigan stream there darts a three-pound trout, planted there years ago by the Secretary of this Society, but alas! this unkind trout has brought many a drop of sensible perspiration to the placid features of Hon. Herschel Whitaker, and continues to fan himself as the years roll on, without a sign of recognition.

Under that cluster of western lily leaves, resting after a gorge of a two-pound Missouri sucker, lies in perfect contentment a sixteen-pound Mississippi pike, who has broken many a rod in the hands of Hon. W. L. May.

In the shadows of Put-in-Bay's rocky shores, still playing at

will, three and four-pound black bass, "the game fish of our country," glory in the defeat of one of their greatest admirers, in worrying Dr. James A. Henshall, bravely testing the rod of his design, but, alas! too, the good doctor was forced to leave his youthful habits, and now climbs the mountains of Montana, searching for a more gentle bass or for facts on how to catch trout in streams running up hill.

In that quiet stream known for its pious muskalonge, at Chagrin Falls, Ohio, are still three forty-pound monsters of his own raising, who year after year delight in breaking the most complete angler's outfit known to Eastern trade, and seem to laugh at the great fish culturist, J. J. Stranahan, who, in Spanish humility, has retired to the historic waters of Perry's victory for inspiration through the microscope.

Along the meadow streams, whose sparkle and brightness take their source from the hemlock shade, hang verdant branches, extending over pools of speckled beauties, every one known by name, who lay in wait for a graceful drop, but, alas! a fish culturist is seldom a successful fly-caster, and the branches and limbs contain a book of the choicest flies, left there by F. N. Clark, while the trout, propagated by his own skill, know him not.

The push and energy of our American railroad passenger men, in seeking the best fishing lakes and most romantic streams for lovers of the art of angling, has been the means of opening the eyes of our Wisconsin fish culturists, and the Hon. James Nevin, who has just begun to learn how to use, successfully, a Henshall rod, leads the people in seeing that the lakes and streams are over-stocked with fish to satisfy the angler's desire to test their fighting qualities in those deep, cold, clear streams.

On account of Toledo, Ohio, being so closely connected with the good people of Michigan, and that city having more truthful, expert anglers than in all the Western States combined, Seymour Bower finds it necessary to ask his legislator friends to pass a law to "license anglers." He had his eye on Toledo when the suggestion came to him.

Annually the sluggish Missouri overflows its sandy banks and rushes over the bottom lands, changing its current every five minutes; but when it retires within its banks, great pools of water remain, to be cleared, in time, and filled with all kinds of fish inhabiting this muddy stream. Often thousands of black bass are held within its sandy enclosures, and naturally become easy prey to the Nebraska angler. Under the shadows of bottom sycamores, W. H. O'Brien, Omaha's favorite son, annually seeks

a favorite casting spot, and on account of reasons better known to himself and his fair companions, he has yet failed to land a single bass. Broken rods line the banks; tangled lines are in the branches of the trees. As a remedy, Mr. O'Brien proposes to "propagate a bass that will bite at worms and hook themselves," as illustrated in his paper before this Society to-day.

To the fish culturist belongs the honor of adding to the natural and artificial lakes and streams of the East the many species of trout from the Western waters, adding beauty and profit and pleasure to man. It remains for the fish culturist to suggest, and follow the suggestion by active work, the necessary remedies for increasing our fish food supply. The Government looks to educated, experienced men to handle successfully our navy. It must look to the educated, experienced fish culturist to solve the problems of how to increase our fish supply. The statute books of our States are crowded with laws which no one understands, least of all the men who made them, and which for obvious reasons, the Fish Commissioners, are powerless to enforce.

In 1903 the patriotic and public-spirited people of the great State of Ohio will appropriately celebrate the centennial anniversary of the admission of that State into the American Union. It is their purpose to make an exposition of the wonderful development of Ohio in financial, industrial, commercial and social lines. Taking time by the forelock, which is the habit we have in Ohio, the General Assembly, at its last session, enacted such legislation as seemed necessary to carry out the expressed will of the people that Ohio's centennial anniversary be duly commemorated. In their wisdom, the members of the General Assembly selected the rapidly-growing city of Toledo as the most desirable site for such an exposition as might naturally be expected from such a State as Ohio. Ohio was carved out of the old Northwest Territory, and Toledo, resting on a magnificent harbor a few miles from the extreme southwestern end of Lake Erie, is the most central point, geographically, of that territory. We have, too, easy access to all parts of the country by way of our splendid network of railways. On this occasion it should not seem strange if I obey the natural and ungovernable instincts of the true fisherman and extend to this Society, the individual members, and all fish culturists and friends here assembled, a most cordial invitation to prepare themselves for a display worthy of our Association. And on behalf of the hospitable people of Ohio let me include in this invitation the good people of the entire great West, whom we would be, indeed, delighted to have with us. In the light of the past deeds of our

State we feel safe in saying that Ohio doeth all things well, and that this exposition, at Toledo, in 1903, will be an Ohio exposition in every sense of the word.

Mr. Clark: I think that we had better take a recess at this time, as it will crowd us considerably to attempt to close our business this afternoon. There is one paper especially that I am very much interested in that is yet to be read, Dr. Henshall's paper.

On motion, the Society took a recess to 2 o'clock p. m.

AFTERNOON SESSION.

Two p. m.—The meeting was called to order by President May, and Professor Birge read a paper entitled:

THE RELATION BETWEEN THE AREAS OF INLAND LAKES AND THE TEMPERATURE OF THE WATER.

Mr. President and Gentlemen: I am going to speak this afternoon on the subject of the temperature of the small inland lakes, especially as affected by the area of the lake. For the last two or three years I have been working on the biological condition of the inland lake, taking up one point at a time, as my leisure from the University work will allow me to do it; for the past season I have been working on the temperature. The main work I have been doing is on my own lake Mendota, immediately adjoining our University. During the last open season I had temperatures taken of the water at all depths, twice a day during the season, and during the present season from the first of May on, I have been continuing the taking of the temperatures in that same fashion, and I expect to continue the work to the end of the season, hoping thus to get a tolerably complete idea of the changes of the temperature of the lake. In connection with this work I have been carrying on, especially this season, observations of some of the smaller lakes, at Oconomowoc, about sixty miles from Madison. The special point of these observations has been to see what the effect of the area of the lake would be on the depth to which the heat of the sun penetrates into the water.

The temperature of the water is one of the most important biological conditions in an inland lake. The temperature of the surface starts in spring from 32 degrees, and rises in summer to the very considerable height of 70 or 80 degrees, and falls again at the close of the warm season to the freezing point. This great gain of heat during the summer is caused, of course, by the action

of the sun. The questions I have been trying to determine are these: How far does the heat of the sun penetrate into the water, and how does it get down to the depth which it actually reaches?

The heat of the sun falls on the surface of the lake, and there are three ways in which the heat may penetrate through the surface to the deeper water. In the first place, it may go down by conduction; the warm water warming by conduction the stratum immediately below it. This method is practically of no importance. The power of the water to conduct heat downward is so small that it may be entirely neglected.

The second way in which the heat may get down is by the direct action of the sun shining down into the water, penetrating it and warming it as it goes. This method means a good deal more than conduction, although it means a great deal less than is ordinarily supposed. By far the greater part of the heat of the sun is stopped by the first layers of the water and gets no further. All the heat that belongs to the dark portion of the sun's rays is stopped by a very thin layer of water, and that part which is in the luminous portion of the spectrum is very rapidly absorbed, especially if there are plants or other opaque particles in the water. If, then, the temperature of the water depended on the penetration of the sun's rays, and if the water were entirely undisturbed by the wind, we should find a high temperature only to a very small distance from the surface, and then we should find a very rapid change to cold water below.

But as a matter of fact, our lakes are exposed to the action of the wind, and this action constitutes the most important means of distributing the heat of the sun to the layers of water below the surface. The action of the wind sets up currents in the water, which distribute to a greater or less depth the heat which the surface secures from the sun. As a matter of fact, we find in the middle of summer a layer of water, often 20 or 30 feet in thickness, which has been almost uniformly warmed by the sun. The thickness of this layer depends not on the depth to which the sun's rays penetrate the water, but on the action of the wind distributing to a greater or less depth the surface layers which have absorbed the heat of the sun.

It follows from this method of distribution that the depth to which the water is warmed will depend upon the action of the wind, and if lakes in the same region are compared, which are equally exposed to the influence of the sun and wind, the amount of warm water on the surface and the depth which the heat of the sun will reach will depend very largely upon the area of the

lake; or, in other words, if you compare lakes in the same region and of approximately the same depth, you will find that the temperature at any given depth will be less as the area of the lake is smaller. In order to illustrate this point, I have brought in a diagram on which I have platted the temperature curves of four lakes. The largest of these is Lake Mendota, 6 miles long, by 3½ miles wide, and about 85 feet deep. The second is Okauchee Lake, about 2 miles by 1½, and 95 feet deep. The third is Mouse Lake, about 1 mile by 1-3 of a mile, and 60 feet deep. And the fourth, Garvin Lake, is about 1-4 of a mile long and half as wide, and about 40 feet deep.

The temperature of these four lakes was taken on the same day, on the afternoon of the 12th of July, 1898. If you look at the curves you will see in the first place that the lakes have substantially the same surface temperature. They are all within about one degree of each other at the surface.

Secretary Whitaker: All taken at the same hour?

Prof. Birge: No; because one has to go from one lake to the other.

In the accompanying diagram each vertical space represents 10 feet in depth of water, and each horizontal space represents 5 degrees Fahrenheit of temperature. The temperature of the water in each lake was taken at every meter of depth, the result platted in the diagram in its appropriate place, and the points so marked connected for each lake by a line. Several things appear plainly from the diagram. In the first place, the layer of warm water at the top of the lake is thinner in the case of the smaller lake. In Garvin Lake this layer is about 13 feet thick, while in Mendota, the largest lake, it is nearly 30 feet in thickness, and in the two lakes of intermediate size it is of an intermediate thickness. This shows, of course, the depth to which the wind has thoroughly distributed the warmer surface water of the summer.

A second fact which is very plain is that at equal depths these lakes have a very different temperature. At 30 feet, for example, Garvin Lake has a temperature but little above 45 degrees, while Mouse and Okauchee Lakes have temperatures about 10 degrees higher, and Mendota has been warmed at this depth to a temperature of more than 67 degrees. Similar relations appear at all depths below 10 feet; the larger lake in every case having a higher temperature at any given depth than the smaller lake. A third fact appears with equal clearness, namely, that the temperature at the bottom of these four lakes is very unequal. In Garvin

Lake, the smallest, the temperature at 37 feet is as low as in Mouse Lake at a depth of 60 feet, and in Okauchee at a depth of more than 90 feet. All three of the smaller lakes have a bottom temperature 5 or 6 degrees lower than that of Mendota at a depth of nearly 80 feet. This feature of the temperature also depends on the action of the wind. The water at the bottom of a lake acquires most of its warmth between the middle of April and the middle of May, and the amount to which the bottom water would be warmed is largely dependent on the action of the wind during that month. It follows, of course, that the larger lake will acquire more warmth than the smaller lake. As the season advances the gain of heat at the surface is so rapid that the surface water becomes warm to such an extent that the wind is unable to distribute it through the deeper water. This condition is reached earlier in the smaller lake, and the time during which the bottom water can gain heat is consequently shorter, and the effect of the wind is smaller during this time. The bottom temperature is therefore lower.

You see, therefore, that the water in lakes of different sizes may possess a very different temperature at the same depth, and that the bottom temperature of a small lake is likely to be lower than one would expect from its depth only, and that of a large lake is likely to be higher than its depth alone would indicate. In Garvin Lake, indeed, at a depth of less than 40 feet, the bottom temperature is about as low as in Lake Geneva at a depth of nearly 150 feet, or in Green Lake at a depth of nearly 200 feet. This is because Green Lake and Geneva Lake are seven or eight miles in length, and are therefore exposed to a much greater action of the wind.

I don't know that I ought to say that these considerations have any immediate practical bearing on fish culture, but I think that any one must see that the small lake, with its shallow water and cold bottom temperature, must form a different kind of home for the fish from that afforded by a lake of equal depth but different area, and consequently different temperature.

Mr. Whitaker: How about the shallower lakes? Is the source of supply the same as that of the others? Are they spring fed?

Prof. Birge: Yes, I believe they are spring fed; the temperature of the spring water is very close to 50 degrees, so that the temperature here at the bottom of this lake is now four or five degrees cooler than the temperature of the spring water. There

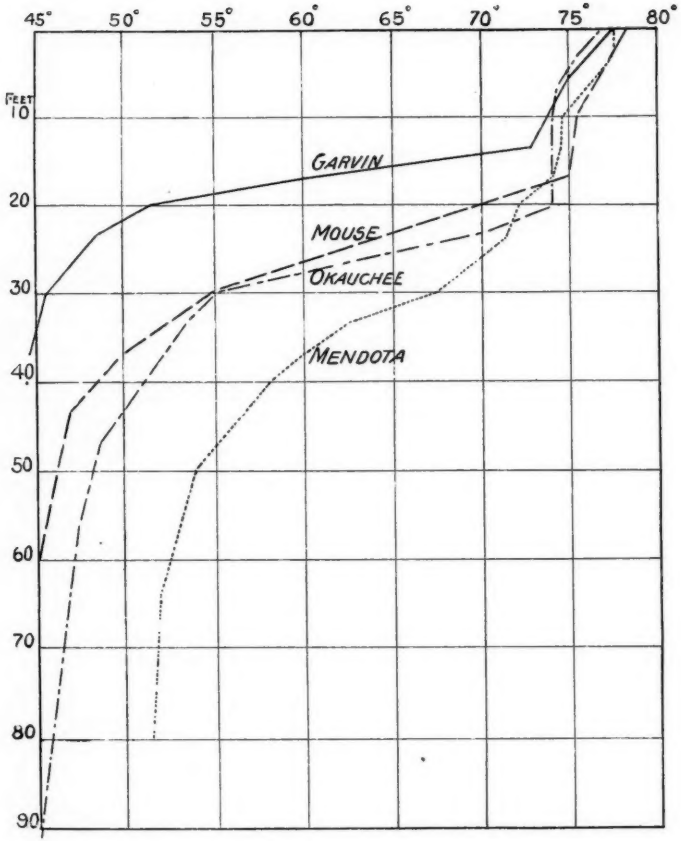


DIAGRAM TO ILLUSTRATE THE EFFECT OF AREA ON THE TEMPERATURE OF LAKES.

(Observations, July 12th, 1898.)

is a spring which I have tested about a mile from Garvin Lake whose temperature is about 50 degrees.

Mr. Whitaker: Have you ever made any observations with reference to the abundance of plants at the bottom of the lake?

Prof. Birge: No; I have not had time to take that up.

Mr. Whitaker: Do you know at what depth in these lakes the growth of plants stops practically?

Prof. Birge: It wouldn't get down to that cold lower water, anyway. You don't get a great many springs in the bottom of a lake. As a matter of fact, the spring would be more likely to come out near the level of the lake than further down. The spring comes from the head of water that is in the soil. When you get down below the level of the soil water there is less head of water. So the spring will ordinarily work out of the edge of the lake or in shallower water.

Mr. Whitaker: I believe the investigation of Lake St Clair showed that the bottom of the lake was covered with a perfect mat of chara. As I understand it, on all lakes there is a certain shore zone, bare of plants; made barren by the action of the waves, which prevents the growth of plants.

Prof. Birge: Not in these very small lakes. In Mendota, except at sheltered places, the wind affects the plants to a depth of 3½ to 4 feet.

Mr. Peabody: What is the greatest depth that the action of the wind reaches so as to modify the temperature?

Prof. Birge: So far as I know, its action extends to the greatest depths of our inland lakes. Green Lake is 237 feet in depth. The temperature of the water at the bottom rises during the spring and falls during the late autumn. I cannot conceive that this change is due to anything but the action of the winds.

Mr. Bower: I think your statement explains why some of the Great Lakes are more prolific as to production of fish than others. I understand that the greater amount of water life, the greater vegetation, the greater amount of fundamental life, the larger the higher forms of life. Of our Great Lakes there is no lake that begins to compare with Lake Erie in the amount of fish caught. There are large areas that are sheltered, but still subject to the action of the wind all the year, in a degree; that accounts for the reason why the most productive places are the bays; take all the bays on the Canada shore, and Sag-

inaw and Green Bay, and they are by far the most productive areas. We get more fish in those parts of the lake than all the rest of the lake; don't you think that temperature in a great measure accounts for it?

Prof. Birge: I have no doubt that this has influence; but I don't really feel that I know anything about the problems the Great Lakes offer in regard to temperature. The shallow nature of Lake Erie must permit the sun to warm it up; you get the whole heat of the sun concentrated on the shallow water. While the heat is projected to a slight depth only in Lake Michigan, it produces a great deal of warmth in Lake Erie.

Mr. Bower: Take the whole of Lake Erie west of a point drawn across the lake from the east part of Sandusky Bay and there is not a spot anywhere that exceeds 46 feet in depth. There is a vast area there of a great many square miles.

Prof. Birge: The temperature at the top and bottom would probably be about the same.

Mr. Bower: It would seem from your explanation that the lake would be stirred from top to bottom.

Mr. Gunckel: I don't think there is probably any question that in the upper end of Lake Erie, the locality Mr. Bower has spoken of, that in the fall it is stirred from the action of the waves and wind, from top to bottom. From the fact that in very heavy winds when the whitefish are on, they are driven off when these heavy winds occur, and it must be stirred from top to bottom.

Prof. Birge: I might say also, where you don't get the water roiled, the wind has a great deal of effect on temperature; take it in Lake Mendota, the wind does not stir the water up from the top. There are horizontal currents which are moving around, which must produce a great deal of effect on the temperature. You will see in the diagram little irregularities in the temperature, which were not to be accounted for by the warming of the water. At 12 o'clock the temperature would be up a degree, and at 3 o'clock it might be down, and at 6 o'clock it might be up. We found continuously little fluctuations in the temperature which could only be due to currents flowing more or less horizontally.

Mr. Bower: I remember when I was a boy and used to go in swimming, we used to suddenly plunge into water that

was perceptibly colder; it would only be just for a few feet and it would be warmer again.

Prof. Birge: That experience you will get, ordinarily, in the early part of the season, but not later than the 1st of July.

Mr. Whitaker: I suggest if there is no more discussion on this paper that we read one more paper and take a recess until to-morrow morning at 9 o'clock.

Dr. J. A. Henshall's paper was then read, which follows:

SOME PRELIMINARY OBSERVATIONS CONCERNING THE ARTIFICIAL CULTURE OF THE GRAYLING.

The grayling of Montana exists only in the tributaries of the Missouri River, above the falls, but principally in the three forks of that river, the Jefferson, Madison and Gallatin Rivers, and their tributaries.

In 1805 Lewis and Clark found the grayling near the headwaters of the Jefferson, and in the history of their wonderful expedition spoke of it as follows: "Toward evening we formed a drag of bushes, and in about two hours caught 528 good fish, most of them large trout. Among them we observed for the first time ten or twelve trout of a white or silvery color, except on the back and head, where they are of a bluish cast; in appearance and shape they resemble exactly the speckled trout, except that they are not so large, though the scales are much larger; the flavor is equally good."

This fish was not subsequently identified from this description, though any one acquainted with the locality and the fishes of the headwaters of the Jefferson could not doubt for a moment that the grayling was meant. Dr. Elliott Coues in his edition of the History of the Lewis and Clark Expedition, thinks the description applies to the blue-backed salmon (O. nerka) of the Pacific coast, though he says this genus is not known to exist in Atlantic waters.

In a recent communication to "Forest and Stream" I have advised the adoption of the name Thymallus lewisi for the grayling, on the strength of Lewis' description, and to relegate to synonomy Cuvier's name of Thymallus ontariensis, based on a specimen, the locality of which is unknown, though it was wrongly attributed, as I believe, to Lake Ontario.

Seth Green and Fred Mather claim to have hatched the grayling artificially from eggs procured in Michigan in 1874. Seth Green has a brief notice in his "Fish Hatching and Fish Catch-

ing" of the hatching of about 100 eggs, but says nothing, except in a general way, of feeding and rearing the fry. I have an impression that Mr. Mather has reported his operations at greater length, but I do not remember just when and where his account was published.

The first real effort in this direction was inaugurated last spring by the United States Fish Commission at a sub-station connected with the Bozeman (Montana) Station, and situated on the inlet (Elk Creek) of Red Rock Lake, the headwaters of the Jefferson River. This auxiliary station was in charge of Mr. A. J. Sprague, who was detailed from the Leadville Station, and worked under my direction.

Mr. Sprague took some 3,000,000 grayling eggs, 1,000,000 of which were hatched and planted in Elk Creek. Fifty thousand eyed eggs were shipped to the Manchester (Iowa) Station, 50,000 to the Leadville (Colorado) Station, and 10,000 to the United States Fish Commission Exhibit at the Omaha Exposition, all of which, by extra precautions in packing, arrived at their destination in good condition. About 1,500,000 were shipped to the Bozeman Station, but many were lost, owing to a lack of ice for packing the eyed eggs. Some green eggs were shipped as an experiment, and though seemingly in good condition on arrival at Bozeman, they all died soon afterward.

These eggs were shipped over a wagon road some sixty miles in a common farm wagon, without springs, and called by courtesy "a stage," from Red Rock to Monida, Montana, thence by railroad. The drive of sixty miles is made in one day, by relays of horses, and as the drivers are required to "make time," the eggs were subjected to much jolting.

The problem of transportation of eyed grayling eggs, however, has been satisfactorily determined. As the period of incubation is so short, it is absolutely necessary that the temperature be kept between 40 degrees and 50 degrees, say at 45 degrees. This can be accomplished by packing ice and dry moss beneath, around and on top of the stack of trays in the egg-case. A good plan, also, is to place an extra ice-hopper, in an inverted position, over the usual hopper; this answers the double purpose of keeping the moss dryer, and also allows more ice to be used on top. It is of the utmost importance that the eggs should not be subjected to the least pressure during transportation. There should be very little, if any, moss placed over the eggs or between the egg-trays. Any pressure on the eggs causes fungus to develop, and is fatal to the life of the embryo.

About 500,000 eggs were hatched at the Bozeman Station, and at least 50 per cent. of the fry are alive, and most of them are feeding.

In stripping the female grayling, the eggs are a little harder to start, but are then extruded more freely than in the case of the trout. About 3,000 eggs is the average for a fish of twelve inches in length. The eggs are white and as clear as a crystal; they are smaller than the native trout (S. mykiss) eggs, but after impregnation and the absorption of water will average one-seventh of an inch in diameter, while the native trout eggs are one-sixth of an inch, and the brook trout (S. fontinalis) eggs are one-fifth of an inch in diameter.

Soon after fertilization the eggs become glutinous and adhesive, forming bunches or masses of various sizes, when fungus rapidly develops and kills the egg. This renders the work of picking laborious but imperative. The embryo develops rapidly, and is in constant motion, often causing the egg to roll over on the tray. The grayling eggs are lighter than trout eggs, almost semi-buoyant, and from our experience would be better hatched under a pressure of water from below. In an improvised jar they did well, and the bunching and development of fungus did not occur. Perhaps the method followed with pike-perch eggs in using starch or muck might cause the eggs to separate, and the bunching be prevented. Next season I propose to experiment with fine quick-sand, so-called, which is abundant about Red Rock Lake; it is more like fine marl, as fine as wheat flour.

The embryo begins to show life and motion before the eye-spots are visible. The eye-spots are small gilt specks, with a minute black pupil, and appear in from three to five days. The period of incubation is from 10 to 12 days, at a temperature of about 50 degrees. The fry are hatched with a very small yolk-sac, about half the size of the egg, and which is absorbed in about a week, when the fry immediately becomes a free-swimming animal, about one-half an inch in length, and is quite slender and delicate. They do not begin to feed so readily as trout, and require constant coaxing, as often as every half hour, with liver as finely divided as possible, being in fact bloody water. The best method of feeding and rearing is yet to be determined. Those hatched and planted in Elk Creek did well, being double the size, at the same age, of those hatched at Bozeman Station, which proves that we must follow, as closely as possible, the natural conditions of breeding.

The grayling does best in sandy and gravelly streams, with

swift and pure water. It is a much superior fish for the table than any of the trouts, and in game qualities is their equal. As the species is rapidly disappearing, it seems to be important that so good and beautiful a fish should be preserved by artificial propagation, and no reasonable efforts should be spared to determine the conditions best suited to its successful culture.

Mr. Clark: This work of Dr. Henshell is a matter that I am very much interested in. In the year 1885 the United States Fish Commission gave me instructions to proceed to the Au Sable River to investigate the spawning of the grayling, and I will say, by the way, that I kept a report of that trip, and meant to have it here. At that time Mr. Bower was my assistant. He was dispatched to the Au Sable and we succeeded in obtaining a few grayling eggs. I think there were 25,000 taken to Northville. Of that number, 5,000 were shipped to Washington, and from there sent to Wytheville, Virginia. There was no difficulty in shipping them. The experience we had in hatching them was something different from the Doctor's. We had no trouble about the eggs sticking any more than with trout eggs, and they didn't bunch up after we had them on the trays. They of course adhered slightly, but after you had separated them there was no bunching. We had no difficulty in hatching them; the difficulty with us was in raising them after they were hatched. The time we used in hatching in a temperature of probably 55 degrees was from fourteen to twenty days. At the time Dr. Henshall was about to commence the work I received a letter from my chief, Mr. Ravenel, in Washington, in reference to the Doctor's taking hold of that work, and he asked me what I would suggest as an apparatus for hatching. I suggested the jar if they were to be handled in large quantities. I see the Doctor did try the jar. I don't know whether you gentlemen have seen the young grayling at the Exposition grounds, but when you do I think you will say they are different from the young grayling we hatched in 1883.

Mr. Bower: At the time we attempted to secure the grayling from the Au Sable and Manistee Rivers, those streams were literally filled with logs. Of course, the fish at that time of the year didn't bite freely, and the only way we could get them was by bottom fishing, using worms or minnows. The opportunities for fishing were limited to occasional open spaces in front of where logs had lodged. We succeeded in getting between 40 and 50 adult grayling, none of which were ripe. We held them in crates a few days, until ripe, and in this way secured about 50,000 eggs.

They were quite different from Dr. Henshell's in color. He speaks of their being white. Ours were not white, but translucent; in fact, they looked about like the Lake Superior whitefish eggs. On two points there seems to be a radical difference. One is that our eggs were non-adhesive, and the other is that they were not white.

Mr. Clark: I would like to state further that Mr. Bower sent down to Northville a certain number of adult grayling, and among them I found a ripe one the same day they arrived. We took the eggs from that fish and they amounted in number to a little over 5,000.

Mr. Peabody: Your experience in Michigan is that it is not profitable to raise them? Have you succeeded in doing it to any extent?

Mr. Clark: We have not succeeded well with them.

Mr. Whitaker: I haven't any doubt in my own mind that there are marked differences in the habits as well as the character of grayling in localities remote from each other. The European grayling and the American grayling differ, and very likely there are differences between the grayling of Montana and the grayling of Michigan.

The streams lying in the upper half of the lower peninsula of Michigan originally contained nothing but grayling and the fish were so plentiful that a lady living at Reed City told Dr. Parker, a former member of our Board, that she had seen farmers come there at the time of grayling spawning, and from under the apron of the dam, with an ordinary pitch-fork, fill a small wagon-box with grayling. The grayling, however, have practically disappeared from nearly all our streams. I have come to the conclusion from my experience that their decadence is chiefly owing to the fact that the spawning season, coming as it does, just before the breaking up of the ice in the rivers, filled as they are with logs, it follows that the logs plow up the beds and destroy the eggs, and that log-running is responsible for the disappearance of these fish from our streams. I introduced a resolution in the Michigan Board of Fish Commissioners at one of its meetings in 1878 to stop the further planting of brook trout in grayling streams and their tributaries. I urged that it was not policy to cease trying to propagate the grayling, and that we should make some experiments looking to the planting of the grayling in waters in which they were indigenous. We passed the resolution and such steps were taken. We subsequently or-

ganized an expedition, quite a number of spawning grayling were obtained, and the fish were held in a preserve where they might spawn naturally. I never was entirely satisfied with the care exercised over those fish in that experiment, but as a matter of fact, it resulted in nothing. We tried it two or three years, but it failed. Seth Green once said to me: "Whitaker, you will never be able to raise the grayling; he is an Indian, and won't stand domestication." And it seems as though he was right.

I don't coincide with the professor's ideas as to their edible qualities. I do not think they can be compared with the brook trout. For fighting qualities they rank well; for the novice fly fisherman they are the fish par excellence, because any greenhorn can get him. Dr. Parker once told me that on a branch of the Manistee River he noticed a little grayling rising to natural food on the surface, and he counted that he rose twenty-seven times.

It seems to me after the experience we have had, that it is a loss of time to try to do anything with the grayling. He isn't worth the trouble. The brook trout is a superior fish in every respect, and responds so kindly and readily to the methods of propagation that it is hardly worth while to do anything with the artificial culture of the grayling. I hope Dr. Henshall will succeed. He is a careful man, a painstaking man, and it is quite possible in that country where the streams are not subjected to log running he may succeed. I think it may be possible that this massing of eggs he speaks of is due to the injury they received in the sixty miles of haul.

Mr. Clark: As a partial answer to Mr. Peabody's question of why we abandoned the work, I should say, as Mr. Whitaker has said, that they are not easily domesticated. At Northville we proved, beyond a doubt, that you cannot do anything with the grayling in confinement. You have the fish, but you simply cannot get any eggs from them. This was also the experience of Mr. Babbitt, of Michigan, who has also experimented with them. I sometimes feel it is too bad that the grayling in Michigan streams are going. I wish the Commissioners might have reserved one stream until log-running was finished. It might be well for the United States Commission to bring some of the Montana grayling and plant them in some of those streams, because they never can do any hurt; they never eat any trout; it cannot do the harm the brown trout of Germany do. I don't think it is practical to undertake to get grayling eggs in Michigan now.

Mr. Whitaker: It is possible we may always have a few grayling in Michigan.

Mr. Peabody: I would like to ask about the temperature required for grayling. Will they stand as warm water as the trout?

Mr. Clark: No; I don't think they do. The Au Sable River is 65 degrees when the air temperature in the shade is 98.

On motion a recess was taken until 9:30 a. m. of Friday, July 22d.

FRIDAY MORNING SESSION.

Friday, July 22d, 1898, 9:30 a. m.

The meeting was called to order by Vice-President Peabody.

Mr. Whitaker: We have three papers yet to be read. The first is by Dr. Bushrod W. James, of Philadelphia, entitled, "The Protection of the Pacific Coast as Related to Food Supply."

Mr. Whitaker then read Dr. James' paper, which follows:

PROTECTION OF THE FOOD FISH SUPPLY ON THE PACIFIC COAST AND IN ALASKA.

The great abundance of excellent fish in the northwestern waters, the revenue from which in years past has mounted into millions of dollars annually, would suggest to many persons that the consideration of systematized protection regarding them was entirely superfluous at this time. Yet a cursory glance at the history of the larger animals, whose habitat has been the Pacific Ocean, Bering Sea and the Arctic Ocean, will be irrefutable evidence that it is better to agitate the question before the lesser fish have been threatened with extinction. In the class of valuable fishes in Alaska the great mammals of the water have always been included, but of one of the most important, the seals, nothing can now be said, as their protection, having been submitted to arbitration, must depend upon the decision so secured; time alone being able to demonstrate its efficacy.

Whales, sea lions and walruses, however, remain without any safe-guard, and their annihilation has been imminent for several years. As food fish they have always been most valuable to the natives of the territory, as have been the same family of creatures to the inhabitants of Greenland, on the Atlantic coast. The neglect to provide some protection to the Atlantic whale is well known to be most disastrous, the whaling fleets having found themselves compelled to quit the business because of the scarcity of their prey, until now, it is stated by an influential journal, that if it were not for the occasional success of whaling in Alaska, the business would be completely degenerated. As it is, the falling-off has been so great that even the Pacific whalemen are turning their talents in another direction. The great value of this animal to merchants is well known, but now the reduction of the quantities of bone and oil has sent the prices upward phenomenally, putting them beyond the tradesmen, who find few consumers

willing to pay the advance, rather accepting cheap substitutes instead.

But it is of them as the life support of Alaskan coast natives that I am inclined to speak at present. Until another mode of supplying food, clothing, shelter, boats and fishing implements, and even fuel, has been instituted for the extreme coast natives, they must have whales and walruses, or perish. It is the diminution in the number of these that has sent tribes of natives far from their usual resorts. It has been the seasons when only one or two of the great animals appeared that have made primitive settlements desolate and reduced the inhabitants to pitiless destitution. This state of affairs has not been sounded from one end of the world to the other, because the Alaskans are neither a warlike nor a complaining people.

For the sake of humanity, as well as for the very momentous item of wealth, there should be legislation limiting the catch of all other mammals as well as their acknowledged superior, the seal, until they have been permitted to increase, and after that there should still be a close guard against over-stepping a proper margin. It is not yet too late, but delay will certainly lead to the total destruction of a once most lucrative traffic in bone, oil and ivory, for the latter of which the immense walrus was hunted until his presence is seldom found in his former haunts.

The history of these fisheries will tell how all the civilized world sent large fleets for the capture of the animals, and how reports gave glowing accounts of their inexhaustible numbers.

But what were they in comparison with the millions of salmon than can literally be forked out of the water as fast as a man's arm can use an ordinary drag net? They are said to haunt some of the rivers during their run in such compact masses that the barefoot natives can walk over them and dip baskets down into the moving schools, removing hundreds, only to make room for thousands more. Speculation has pointed the way, and canneries have appeared with enormous capacity. It was so in Karluk River some years ago; now, the United States Treasury Department has officially stopped salmon fishing in Karluk, except that sufficient fish may be captured to supply the hatcheries along the river banks; and this is done to prevent threatened depletion. Yet it is stated that the Pacific coast fisheries will require about 80,000,000 cans for their year's catch, as they have used that number annually for several years. Many of the fish are taken in traps, and from 10,000 to 40,000 salmon are taken in one trap. It must be remembered that all this number cannot possibly

be choice, and there is no doubt that thousands are wasted because of undersize or non-marketable quality. But to remedy this defect some companies have permitted them, and the different kinds of fish taken with them, to appear under the same label as the better article. Dealers have fortunately discovered this, and the only thing for the canners to do to redeem their reputation is to exclude all but the finer quality, as they did heretofore. Perhaps there has been some excuse for this in the falling-off of the Columbia River salmon, whose excellent qualities have created an enormous demand, and in filling standing orders the workmen may have in haste made mistakes in the canning. Or, more probably, inferior qualities have been carelessly handled among the better and received the sign manual that had belonged previously to none but the superior article. Possibly disaster has befallen some firms through this unprofessional handling. But the streams are still so well stocked with the fine grades of salmon that no one need suffer long who has the energy and the capital to start in anew, with thoroughly reliable stock.

The "Royal Chinook," whose magnificent proportions have often tipped the scales at eighty-five pounds, whose beautiful deep-pink flesh has charmed the epicure, is still abundant in the North-West, though a little caution in the catches will be necessary to keep up the supply. But he has a rival, so small as to seem at first hardly worth fearing; its name alone being anything but attractive. Yet, the little six to ten-pound "sock-eye" has certainly swam to the front. Its beautiful red, firm and richly-flavored flesh, and its preserving qualities, have nearly overshadowed its royal brother, as well as the Alaska salmon of the greater rivers. But here come announcements of new companies who will pack nothing but "sock-eye." Puget Sound fisheries, wherein the fish are caught on their way to Fraser River, are preparing to take greater numbers than they did before, for the reason that the exports call for the rare, new commodity. More canneries are to be erected at Astoria for Columbia River salmon, at Fairhaven for the Puget Sound fish. In Washington, new traps are to be put in place for the expected rush of the salmon. Companies are forming and locating for salmon fishing. Cold storage plants are being erected for the salmon catches in different parts of Alaska, Washington, Oregon and British Columbia. A Dane has patented an arrangement by which fish can be carried great distances while still alive, and the device is to be used in carrying salmon as far east as the fish will keep. The result of all this must be distinctly foreseen by any thinking person. One day,

not far distant at this rate, salmon will be so scarce that the canneries will be forsaken and capital taken in another direction, whereas, if the Treasury Department or its representative Fish Commission, will place restraining measures upon this evident wholesale grasping, confining the seasons, prescribing the fishing until a number of the strong, finer fish have had time to reach the spawning grounds, and thus perpetuate their species; the salmon fisheries will not be exhausted as they must be soon, judging from the stupendous preparations that have been made for their extermination.

One manner of preserving them as well as other fish, is by allowing a fish-way in every dam, by prohibiting the erection of enormous traps and wheels that must soon depopulate the waters of all kinds of fish, unless it is expected that fish themselves will discriminate and keep out of the way; by insisting upon limited seasons, and by also requiring companies to avoid over-production of their commodities. It is not desirable to keep fish, particularly, from season to season. The fresh article is always in demand, but there is a certain modicum of danger in keeping them over. Having estimated the quantity required for a year's trade, it would be only diplomacy to stop at that, and let the fish have liberty to grow and multiply. Our Fish Commission is cognizant of this, and with Government to legislate there will be no danger of the salmon canning business becoming a failure.

It has been said of Americans that they are greedy for wealth, but the desire for revenue from fish has dominated every nation, and when our laws are prepared for the protection of salmon in Alaska and Puget Sound, we will evidently be required to gain the co-partnership of British Columbia, else some of the more valuable kinds will not be fully guarded.

Another great fishing scheme is being advanced rapidly of late, for the taking of sturgeon, Pacific sturgeon being found finer flavored, firmer in flesh and better for keeping than the Atlantic fish. Possibly, there is little wonder for this when we think of the pure, almost unknown waters in which the former live, and the uncleanly waterways in which many of the Atlantic sturgeon are caught. In Fraser River the sturgeon has been found of great size and richest flavor. One fish was taken that weighed over 900 pounds. This fish is to be shipped by cold storage; the roe will be sent to Russia for caviare making, and the Chinese prize the spinal cord after it is dried. There seems to be no idea of canning the sturgeon, though it has been whispered that the same has been found masquerading as salmon in some grades of canned

goods. Sturgeon is sufficiently well known to be appreciated under its own name if it is properly handled. And here a word with regard to the matter of handling. I think the fisheries are endangered by the manner in which many fish are marketed. Perishable as they are, the housewife is cautions in purchasing unsightly fish, and the Commission should ask for local legislation that will dominate the sale of fish in every market. If this was established, more fish would be used and less left to waste offensively. Thus far there is unquestionably an over-production of all but a few choice varieties. With careful manipulation all fish would be more tempting, and if the purchaser did not see the fish that was wanted she would possibly take another not very inferior. To protect the fishing interest everywhere, the fish should be delicately handled to prevent unsightly appearance, and they should be fresh beyond all doubt.

To prove that a limitation of the catches of the different fisheries will permit the numbers to attain a certain annual average, we will find that the species that have thus far been allowed comparative freedom are found in amazing quantities in their haunts. Smelts and herring, perch and pompano, cod, halibut and mackeral, trout and many other varieties can actually be captured by the ton in virgin waters. We must look to it that none of them are so captured until the waters are suddenly depleted.

In this connection I wish to speak of carp, some of which grow to the size of fair specimens of sturgeon. I was one time criticised for stating that these carp destroy other and more valuable species, but to-day there comes the complaint that young fry are being devoured by carp. As this fish has proved itself less desirable than was expected, it would be an excellent idea to allow it to be taken in all ages and sizes, or else these ravages will materially injure the business of the hatcheries.

A comparatively new business is progressing finely in the northwest in planting and preparing oyster beds and the better quality of lobster has also been transplanted. Puget Sound oyster canneries have only been in full operation for three years, and in that time they have increased in value one hundred and fifty per cent. Here again the danger threatens that injuries every other part of the fishing business. It is, as soon as the product shows phenomenal success other companies rush in to claim a share, and thousands upon thousands of really almost unsaleable stock will be spoiled in the pursuit of the more desirable kind. Let the fisheries get a good start, then allow just a reasonable amount to be taken at once; in time, the supply

will increase to meet the greater demand, and the northwestern oyster fisheries may be looked upon to make up in a measure the great falling off of the Atlantic product.

It was this falling off that led Seth Green to open his eyes to a stern necessity for replenishment, when, in 1864, he began experimenting in artificial propagation of food fish. The good that his work has done now extends from one state to another all over the breadth of our land. The fish commission has become an institution of the Government, and to it the Pacific as well as the Atlantic fishermen and dealers look for supplies of some of the most valuable denizens of river and ocean. Through the efforts of the commission salmon has been restored to the east and shad made known to the great west. From this we must be assured that their every effort should be appreciated and their millions of fishes protected from extermination. To do this plans must be legislated to prevent the vast numbers of the products of the waters to be met with yearly increasing arrangements for their destruction. Because an immense haul is expected, greater facilities are greedily and hurriedly completed, as if it were not wiser to permit this year's fish to insure as great results for next year.

But a short time ago we heard of the "sock-eye" salmon, next we hear of the millions that are taken and the great wealth that is being expended upon new fisheries for their capture. Oysters are becoming abundant, therefore, on rush the speculations regarding them, the calculations of their value this year by their lesser value last, until in very little time there will be more deserted canneries, more buildings to fall to decay, more men disappointed in employment, more speculators mourning over financial loss.

Another trouble appears at this present crisis, as the Atlantic fishermen have decided to join with those of the Pacific in cod, halibut and other fishing. The war is truly blameable to an extent for this, but, indeed, the Atlantic fisheries have been in a doubtful condition longer than the war can have been threatened, taking even the first grumble ten years ago. Unquestionably, the United States Fish Commission will find ample work on either side of the Union to provide a large enough supply for the dual demand. This cannot be done by propagation only, but by a judicious economy in the fishing permits granted to companies, or even individuals, as some are quite equal to carrying on a large independent business. Therefore, the commission should first extend the jurisdiction so as to embrace all the fisheries, even the sponge fisheries of Florida. But as I am par-

ticularly limited to the Pacific coast, I should say that no fishery should be entirely independent of the commission's careful supervision, even where the myriads of fish seem to promise inexhaustible supplies. It should guard all from depletion, and by so doing the profit will continue at a consistent ratio over decades, or we may say, centuries of prolific business, instead of being rushed through at lightning speed, with but a few individuals or corporations gathering the enormous profits, leaving so little that even the natives of the most distant points will suffer, if not perish, for want of their annual complement of nature's provisions for their maintenance.

A grand movement in the proper direction has begun in the establishment of schools for the study of the habits and culture of fish. In the pursuit of this subject, for instance, I find that the Fraser River salmon has a supply of oil in its composition which aids in the preservation of the flesh, and it suggests to my mind the utility of compressing the oil from the heads and tails, the discarded parts from the canneries, and using that oil for the preserving of these salmon and others of different kinds that require the addition of oil.

I would second the idea, also, of inventing some plan for using up the skins, heads, tails and other refuse, not only of sturgeon but of all fishes at the canneries. The prevention of the enormous quantities of offal being left to render the atmosphere pestilential would be no less desirable than that so much objectionable matter should not be returned to the sea in decomposing streams when rain fell in copious showers, thus providing literal poison for the living fish. And this kind of protection is extremely desirable, for even in the waters of Alaska fishes have been found with diseases or with parasitic enemies that cause sloughing. At first this latter trouble would seem like a sort of cankerous malady, but it is known that fish never renew their scales, nor do those that have no scales renew their skin to its normal condition after having been injured. If then, the parasite that renders one fish unsightly is freed from that fish and cast among others it is natural to suppose that the objectionable creatures will multiply upon the other fish with which they come in contact.

With limitations in the catches, even to the establishment of off seasons when necessary, I would earnestly suggest that the refuse matter from every cannery or drying and salting station should be turned into oil, glue, or possibly, dry compost. And if none of these commodities can be obtained from it, then let the

useless offal be burned, either chemically or with fire. I should think that there could be cheap furnaces made of rocks and stones, and the fires once started could be kept up by the judicious distribution of the refuse. Would it not pay to consume or otherwise decompose the matter that will assuredly injure the very young and delicate food fishes, the flavor of which is their chief attraction to the consumers?

That California has its profitable fisheries, that Mexico has opened the Pacific coast of Lower California to the world of fishermen, that Alaska and British Columbia teem with millions of salmon and other fish does not say that there need be no more thought of economy or protection. A glance will show that both are now more absolutely requisite than ever, for the tide of the Atlantic will turn to the west in colonies of disappointed, heart-sick men who know nothing but how to take and cure the food productions of the sea. They will flock toward the fishing grounds as do the gold seekers to the new Eldorado. It will not do to wait until their migration happens. It would be ungenerous to let them go and then supply laws of which they know nothing. Instead, let the commission carefully prepare schedules of the regulations that they know to be required for the protection of the fishes, and through that for the longevity of the fisheries, and follow this by presenting them to the proper authorities for inspection, consideration and legislation. Follow the matter so that it must be put through quickly. Include every kind of fishery in this—that is, the oyster and sponge and pearl, as well as well-known fish from whale, seal and walrus, down to the tiny, delicious smelt. If this is done now while these fisheries are in comparative infancy, there will be no danger of extermination, no cry from men who have lost their legitimate business through ignorance or carelessness.

There is, and will be, increased demand for canned fish, as they are now included among the stores for army and navy, but there is great fear of over-production, particularly if the war is soon ended. Then it becomes again necessary to warn, not only against over-supply, but also against using any but the best manner of preserving fish, so that no one can be injured when the goods are cheapened and sold to the people.

As food, fresh fish well preserved and carefully canned, is desirable both for health and variety of menu. But diseased, decomposed or chemically tainted fish is not only an abomination but an active poison.

When preparing the new fishing laws, this phase of protection

should be most elaborately introduced, for the selfish reason that people will not buy any goods of the kind if the reputed harm they do is accepted as fact, as well as for the humanitarian reason that it is unjust to permit inferior commodities to get in the market.

When all things have been done to prevent over-supply, overfishing even in teeming streams, and improper preserving—when the rivers are protected from poisonous matter, and all the parts of the production are utilized, then may the commission promise, through these protective laws, and increasing numbers of artificially hatched fish, to make the fisheries of the Pacific States and Alaska as nearly inexhaustible as it is possible for such to become.

I know that there has been squabbling and dissatisfaction between Washington and Oregon, between Alaska and British Columbia, and this proves that both States and countries must conjoin, nationally and internationally to protect their fish, and then to amicably share their profits in the animals which make both States and nations equal as they pursue the beautiful tenor of their lives among the intersecting waters that make all States and countries their own.

Mr. Whitaker: The next paper is one prepared by Hon. John W. Titcomb, commissioner of fisheries and game of Vermont:

DESISABILITY OF STATE ORGANIZATION FOR THE PROMOTION OF FISH CULTURE AND FOR THE PROCUREMENT OF STATE LEGISLATION FOR THE PROPAGATION AND PROTECTION OF FOOD AND GAME FISHES.

The objects of the American Fisheries Society obviously cover the title of this paper to the extent that it might be more plain to the members if it read: Desirability of State Organizations for Promoting the Objects of the American Fisheries Society.

Nature liberally provided the waters of the world with food for man and has been lavish in allowances for waste both from natural and artificial causes and the improvidence of man. With the progress of civilization, the increase of population and the change in natural conditions caused thereby with the consequent increased demand for fish food, the lavishness of nature is set at naught. It will be conceded that the fish in the waters are intended for the use of man. Their protection then is simply a

safeguard to prevent the supply from being exhausted and to make the production, whether artificial or natural, as useful to man as possible.

It will be conceded by all members of this society that the artificial propagation of fishes has passed beyond the experimental stages and that it is political economy for States to engage in fish culture. It will also be conceded that nearly all fish must be protected at certain seasons if they are expected to reproduce their kind and nature is to assist in the work of the hatcheries. How many of our State legislatures are convinced as to the desirability of propagating and protecting fish to the extent that wise laws prevail which are not subject to radical changes or repeal at each recurring legislative session? Nearly, if not all, the States have some kind of protective laws, some wisely drafted and more that have no reason for existence. Protective laws, so-called, often defeat the very object for which they are enactd. It is a common custom for legislators who want more liberal laws, which, for example, provide for the use of nets in waters where nets should be excluded, to draft a bill reading somewhat as follows: An act for the protection of fish in Lake ..... and then follows a bill providing for the extermination of fish in said lake.

In listening to many valuable papers read during the National Fisheries Congress at Tampa last January, of interest to both sportsmen and commercial fishermen, I was impressed by the fact that almost every paper, scientific or otherwise, alluded to the question of legislation and the condition of public sentiment. If the paper did not allude to legislation, the discussion which followed its reading would do so. Examine the laws of any State and many will be found which are practically void. I do not refer to fish laws in particular, although this class of legislation will be found in the above category quite as frequently as any other. Two reasons will be found for the lack of observance of void legislation. First, the laws may not be wise ones and have no good reason for existing. Second, public sentiment is opposed to the laws either because they are unwise or because the people are ignorant of the real reasons for their enactment. This public sentiment may or may not extend throughout the State and it may be limited to one town or one county in the State. If public sentiment throughout the State is opposed to the observance of a law, its enforcement is practically void. If one town or county is opposed to the law, it is for purely local selfish and short-sighted motives, but it tends to make the law ineffective

if its enforcement is left to local officers. It frequently occurs that the small section of a State in which the law is unpopular can send a strong enough representation to the leislature to obtain its repeal against the best interests of the State at large. All such work injures or weakens the efficiency and popularity of protective laws in general. The average legislator becomes disgusted with the frequent introduction of bills for the propagation and protection of fish and pays little attention to them unless such bills are called to his attention as directly affecting the interests of his constituents. He often goes to the capital with certain objects in view and interests himself in executing those objects by the passage of certain bills regardless of other interests. I do not intimate that he is dishonest, but his energy is exerted in the interests of his own constituents. He has not time to investigate proposed legislation on the fisheries, for instance.

If then, the legislature does not believe in the propagation and protection of fish, an organized effort must be made to educate legislators as to the value of such work. The political economy of such legislation must be demonstrated and an appeal made to their pockets. This work should begin by educating the entire people of the State. The education of the people and the shaping of good legislation go hand in hand. The representative of a community is usually chosen because he has been successful in the management of private interests. If he sees that his constituents are interested in certain legislation, he will interest himself sufficiently to act intelligently upon it. I have attempted to show the necessity of organization to promote the objects of this society. I will now describe an organization which has been doing successful work for nearly eight years. It has been said that fish and game protective societies seldom live more than two or three years. Such is too often true, but if they are managed upon a strictly business basis, their period of usefulness will continue as long as the objects and aims need fostering.

At the risk of appearing egotistical because I was one of its promoters, I will describe the Vermont Fish and Game League, how it was organized and what it has accomplished. While its work is confined to a State with commercial interests of comparatively small importance, the same kind of an organization can be effected suited to the needs in other States. Some States already have similar organizations.

Methods of Organization: The first steps taken were as follows: A circular letter was sent to every postmaster in the State asking him to name all the citizens in his town who would be

interested in a State organization for the protection of fish and game. A reply card was inserted. An alphabetical index of all names received in reply to this circular was booked and a second circular was sent to all whose names were thus booked, inviting them to pledge themselves to join a proposed league with the above named objects, to agree to pay a certain fee (in this case $5) when one hundred names had thus been pledged and with the understanding that no articles of incorporation would be procured or organization effected until the one hundred names were pledged. The same circular requested each recipient to send in names of eligible members. Frequently the same names were sent in by several sportsmen in one community, showing the desirability of keeping an alphabetical index of all eligibles to avoid repetition in sending out circulars and to have as complete a record of eligibles throughout the State as possible. In response to the second circular, 111 names were pledged and articles of incorporation immediately procured and organization effected. A meeting of charter members was called, a constitution and by-laws (previously prepared) was adopted and officers elected. Of the 111 charter members, all but one redeemed his pledge by paying into the treasury $5. From the date of organization in 1890 to the present time, the membership has constantly increased, until the present membership is 563. After the first year, the membership fee was reduced from $5 to $3 and the annual dues from $3 to $2. Town and county protective associations were admitted as branch clubs and permitted to send one delegate as a voter in all business meetings. Regular meetings are held annually and special meetings from once to twice per year. At the annual meeting a dinner is given after the business is transacted, followed by post-prandial exercises. The past three years a so-called mid-summer meeting has been held on an island in Lake Champlain. At these meetings many notable men are gathered. On the occasion of the last meeting President McKinley was present as a guest. Politics are not allowed to enter into the work of the league or to be discussed in the meetings nor enter into the post-prandial exercises.

The subjects in which the league are interested are kept constantly before the people by means of cloth posters giving a synopsis of the laws, pamphlets containing the chapter of game laws in full, by frequent circular letters to the members scattered throughout the State and by the voluntary aid of all the newspapers published in the State.

The people must know the reasons for the fish and game laws and that they are not designed for the especial benefit of the fishermen, but for all the people. There should be no protective law—no close season on fish and game without a good reason for it. When the people are convinced that as a matter of political economy fish and game must be protected, they should understand that the laws are framed with especial reference to the habits of each species thus protected. Take, by way of illustration, the statutory limit on fish which can be legally caught—the six-inch law on trout, for example. All the people should know that trout will not reproduce in our streams until they have arrived at an age when they will have attained a growth of six inches or more. They would then understand that if allowed to be caught before they are six inches long, reproduction ceases and with the excessive fishing now prevalent, all trout will be killed before arriving at the age of reproduction and total extermination follows. Artificial propagation and stocking cannot replenish the waste. The same rule applies to the statutory limit on salmon, lobsters, etc. The statutory limit for each species to be legally caught should be one which will permit natural reproduction at least once before capture or there is little argument for the law.

When the league was organized eight years ago, public sentiment was at a low ebb so far as fish and game interests were concerned. With its inception, an appropriation for a State hatchery was secured and liberal appropriations for its maintenance and extension have followed. Through the interest awakened by the league, a national hatchery was located in Vermont. The game laws, which were in a wretched condition, were codified and revised by a committee from members of the league, presented to the legislature in the form of a bill which at the same time repealed all existing legislation of the same nature and became a law almost without a dissenting vote. Our legislators are beginning to consider it a matter of political economy that these interests should be fostered and the league loses no opportunity to present to the public and to the skeptic the arguments which will appeal to their pockets.

I would not have you think that our laws are perfect or that what has been accomplished was attained without hard work on the part of the administrative force of the league. We have asked of our legislature what we thought we could obtain. As public sentiment increases, more desirable legislation will be asked for.

The poacher, like the poor, is always with us. He is only kept in check by rigid enforcement of the law whenever opportunity offers. When necessary, we do not hesitate to send to the city for a good detective and pay the costs out of the league treasury. In Vermont the league is the strong right arm of the Fish and Game Commission.

If any one is lead by the arguments in this paper to organize a similar society, let him consider well two important features. The work connected with its promotion and future success is tremendous. No salaried officers exist, although in a State of such important fishery interests as, for example, Florida or Louisiana, there should be enough of a support to pay the salary of a stenographer.

Work of this nature once successfully undertaken by one or two actively interested persons cannot be dropped by them after the organization has been put into working condition. One man does the most of the work. He should be familiar with the fisheries of his State and not be prejudiced in favor of either sportsmen or commercial fishermen.

We believe in the social side of the organization as contributing largely to its success, but our membership is too scattered to meet socially more than twice a year.

Mr. Peabody: Mr. Titcomb is perfectly saturated with his subject and is the best posted man on that subject in the country.

The Chair: What is the next paper?

Secretary Whitaker: The next paper is one prepared by Dr. Henry B. Ward, which will now be read:

AQUACULTURAL EXPERIMENT STATIONS AND THEIR WORK.

The United States is justly famed among the nations of the world for the rapid advance it has made in methods of agriculture. Primarily this is, of course, due to the sagacity of the people and to their adaptibility in taking hold of new ideas and applying them to the given conditions in any locality. But a most powerful factor in aiding and directing this development has been unquestionably our admirable series of agricultural experiment stations. In every State and territory in the Union at least one such establishment, founded by State liberality and fostered by generous grants from the general government, is working uninterruptedly at the problem of agriculture in that region. In these stations the subject of agriculture has received, for many years, the closest attention of scientific workers. Not only the character of

the different products, their food value for different uses and in connection with the raising of different kinds of stock, but also the preparation and enrichment of the soil, the development of the seed, the growth of the plant, the dangers that threaten it, the diseases that attack it, its protection and improvement, are all subjects of continued investigation.

Contrast with this, if you please, the conditions which exist in fish culture: "Despite the painstaking investigations of a few scientific workers and the encouragement of some official boards with limited means, aquaculture has been almost as much neglected as agriculture has been advanced. The incentive given by the work of Hoy, Milner and Forbes on the Great Lakes a quarter of a century ago has not been followed up; chance has been relied upon to control the conditions in these vast inland seas, and the fundamental features of the problem are as little understood to-day as when there was no drain on the life in these waters. No farmer is so ignorant as to suppose he could scatter the seeds of a grain whose development was entirely unknown over the land of which he was equally ignorant, and leaving the land could hope on his return in the fall to reap a bountiful harvest. And yet this is just what has been looked for in the case of the whitefish." This aspect of the question was very sharply put by Prof. Jacob Reighard in a paper read before the International Fisheries Congress in 1893: "If we inquire into the facts concerning the sufficiency of the present methods of artificial propagation," he says, "we find that so far as the whitefish is concerned, there is no question as to the success of the earlier stages of the process. Several hundred million ova are taken annually and placed in the hatcheries and of these usually from 80 to 90 per cent. are hatched and placed in the waters of the Great Lakes—165,000,000 in Lake Erie alone in 1888.

"This is very nearly all that we know about these young whitefish. About their food habits we know only that in captivity they eat certain species of crustacea. Whether in their natural habitat they eat other animals in addition to these crustacea or in preference to them, we do not know. It is uncertain at what age they begin to feed or how much they require. We do not know their natural enemies. We do not know whether they thrive best in running water or in standing water, in shallow water or in deep water, whether at the surface or near the bottom. What changes of food habits or of habitat the fish undergo as they grow older is still deeper mystery.

"Our problem is to place young whitefish in the Great Lakes

under such conditions that as large a number as possible of them shall grow into adult fish. It is clear that of one of the elements in this problem namely, the whitefish, we know but little.

"What then do we know of the other elements of the problem, the Great Lakes themselves? Individual naturalists have, from time to time, made efforts to study one or another of the groups of animals living in the lakes. These efforts have been circumscribed by the facilities at hand by the time that could be devoted to the subject, by the small area examined, or by the small number of animals taken into account. * * * We are thus in the position of bringing together under unknown conditions, two things, both unknown in character; and we expect as a result to get a third thing, marketable whitefish. Should we not pursue our object more intelligently by first determining the characteristics of the materials with which we have to work?"

What Prof. Reighard has said of the whitefish may be said of other species with equal truth. Clearly present methods have reached their limit and the subject must be attacked from a different standpoint. Aquaculture must be given the same sort of treatment that agriculture already receives at the hands of the thousand trained investigators in experiment stations that are located in every State in the Union. It must be studied from the same scientific standpoint; its problems analyzed, its course marked out definitely. As I have said elsewhere in discussing one side of the problem: "Fish culture will never attain its proper results until it receives, by the liberality of the State and nation, the same favors that have been extended to agriculture, the use of permanent and well equipped experimental stations where trained workers shall devote their time and energy to the solution of its problems. The Great Lakes furnish a cheap and valuable food supply to one-third of our entire population; this food supply is rapidly becoming depleted. How long must such important interests wait their just recognition and adequate protection? And if properly developed, who can limit the possibilities of these inland seas in supplying the nation with food? The urgent need of the present is not a mere biological observatory, however valuable such a permanent foundation may be, but a well equipped and well directed experiment station to attack the peculiar problems of fish culture in the Great Lakes.

The idea is by no means entirely novel and much work has been done preliminary to the foundation of such a station. The classic researches of Forbes on fish foods, of Birge on the crustacea of the plankton and of many other individual observers,

have opened questions of extreme scientific and economic importance. Some years ago the Michigan Fish Commission, under the able leadership of the Secretary of this society, carried on through several successive summers biological investigations first on the inland lakes of Michigan and later on Lake St. Clair and Lake Michigan. For the past three years Illinois has maintained on the Illinois River a biological laboratory where, under the guidance of Prof. Forbes, the problems of a river system have been undergoing careful investigation. The United States Fish Commission has had for years an important investigating station at Woods Hole, but is work has been largely confined to the summer months. Numerous other less extensive enterprises might be mentioned, but these will suffice to show that the time is ripe for such an undertaking of a more formal and extensive character.

If the establishment of an aquacultural experiment station is advocated one may well inquire as to the most favorable location and as to the work it may be expected to perform. And at the start it may be noted that a single station is but the beginning, for just as agricultural experiment stations are found in every State, so aquacultural stations should be distributed so as to afford opportunities for the investigation of all conditions for the development of life in ocean, lake and stream. For the pioneer enterprise one may justly say that a lake presents the most favorable location. It is, as Forbes has said, a world within itself, a unit of environment and has thus evident advantages over the ocean or stream as a starting point for study. In the Great Lakes I believe we possess such favorable units for investigation, while at the same time the economic questions associated with the depletion of the whitefish are of pressing importance. Almost any location which might be chosen on one of the lakes would also afford within easy reach smaller inland lakes for such comparisons as should prove advisable.

Both the general government and the individual States have already in existence more or less extensive plants connected with the various hatching stations, and these might well be made use of in establishing aquacultural stations with evident saving in equipment and working force, since the expensive pumping apparatus, for instance, would serve with little or no modification for both purposes. The intimate association of the scientific experimentation and the hatching might be expected to redound to the advantage of both. It is also evident that such an aqua-

cultural station would be fitly combined with such a large aquarium as has been advocated in Detroit for some years.

Following along the line of successful work in agriculture, such a station should possess a working force composed of men trained for scientific research and, associated with them, assistants having thorough personal acquaintance with the problems of practical fish culture. The work to be done must be attacked in a thoroughly scientific fashion; no superficial study will really succeed in throwing light upon the problems that are presented. To this end the foundations must be laid broad enough to insure the permanent value of the work. And equally with thoroughness continuity is essential; experiments and observations must extend throughout the year and even through a series of years. Herein lies a real danger of the plan, for ultimate success demands that the work proceed independent of results, while impatience for some return is a most characteristic feature of American life.

If the work of an agricultural experiment station is great, equally so is that of an aquacultural. The latter deals with all conditions of existence which present themselves in the water. It seeks to ascertain of what the food of each fish consists, in what amounts it comes and where that food is found, how the amount may be increased and even how it may be improved by the introduction of new elements imported, it may be, from distant parts of the world. Experimentally it would strive to determine to what extent an increase in the number of the fish was both possible and profitable and how this increase could best be attained. Furthermore, in the light of food supply, the investigator would institute comparisons as to the best kinds of fish to raise under given circumstances, and, not content with this, would endeavor, experimentally, to produce new races of fish and to domesticate suitable forms. It is not necessary to carry this analysis further and I only need to call attention in passing to the patent fact that other living forms than fish are of considerable economic importance on the continent and might well be here. The introduction and improvement of such forms would clearly be one function of such aquacultural stations.

The problems outlined are indeed vast, and yet we may be confident that their solution lies easily within the power of the human intellect, for they are all paralleled in the history of the agricultural development of the race; and man, relying upon his success in the past, may go forward with supreme confidence to the attainment of their solution in this new field.

Mr. Clark: I don't wish to take up the time with any argument, but Prof. Ward's paper is right in the line of what I had been advocating for ten years on the subject of the work of the scientists in this direction on the Great Lakes; that it should be continued from month to month during the year. I have argued that the summer campaign of these men has never developed or brought out what practical fish culturists want to know in regard to the habits of the fish in the great lakes. I think that the scientists are taking a step in the right direction. The scientists and the fish culturists and everybody should keep together.

Prof. Birge: I think the paper puts the rule for the conditions of success, extremely well. I don't believe in a summer campaign. With all due respect to the college professors, I don't think they can do that work permanently. I think the work must ultimately be conducted by men who make it their life work, just exactly as with the agricultural experiment stations. We find in Wisconsin that the men who work in the stations do very little teaching. They hold the rank of professor, but they are expected to do little or no teaching. It is found that a man cannot give his time to the problem of agricultural conditions and at the same time do a large amount of teaching. If the man is going to reach real success in handling these practical problems, he must set up with them day and night, week after week and year after year. What ought to be done is for the United States Fish Commission to establish at least one such station and maintain it, as Prof. Ward says, without any expectation of immediate results of a practical kind, and put men in there to study the problems and find out how they can be established. Such a station would utilize the work of the college professor in the summer, and it would be made available; at the same time the work should be carried on by the regular employes of such station. I don't think that anybody can doubt that such a station must be established. When you try to throw even the small amount of work that we have done on a few, you will find at once the dense ignorance you have, you will find nobody knows anything about it; there are a lot of disconnected observations and knowledge that you can pick up, but when you try to get things together in some shape, nobody knows anything about it and nobody will know anything about it until an enormous amount of work has been done on a great number of different classes of subjects and the whole thing has been brought together by a continuance of the work extending over a good many years and when you once get that you can get practical results; such work as Forbes is at

in Illinois is exactly what ought to be done. He is spending about $5,000 a year on the investigation of a single river practically; if he is able to continue that for a long enough time he will get some idea of the condition of fish life in the rivers.

Mr. Whitaker: There is one thing I want to say in connection with this matter. Something like six years ago the importance of this work of scientific inquiry into subjects relating to fish life and culture and the conditions that surround them and have bearing on fish life impressed its importance upon me. The matter was brought to the attention of our board, after a conversation with Prof. Reighard at Ann Arbor, and we determined to establish a field station. A certain amount of money was devoted to that work. The amount of money that was required was very insignificant compared with the value of the work done. It was thought best to make that work permanent, but the economy of the legislature finally compelled us to stop it after having prosecuted it for two or three seasons. I don't think there is any argument needed on the importance of the continuance of this work. It has always impressed itself as a necessity upon me. During his lifetime I interviewed Col. McDonald two or three times on this subject, urging him to take it up, telling him that we would be very glad to surrender the work to the United States Commission, and it was a work that ought to be kept up. At last it has come to the point where the work is liable to be put on a permanent basis. I believe it is going to result in much good to the cause of fish culture. What we want to know is something about the life habits of fish. It would be interesting to know whether there are given areas in the lakes that are stocked with the food of fish more plentifully than others, which would influence the decision as to the most likely places in which to plant fish. Of course, in connection with that there is this question as to the food of the fry. Can we determine anything about the conditions that are necessary to give the best results to be expected from planting? If we can do that we are acting intelligently as fish culturists. We should get at those things which are as important for the fish culturist to know as it is important for the farmer to know the constituents of his soil. It is a fact that this work has heretofore been done in a spasmodic sort of a way and it is a fact that we have been unable to establish anything like a permanent force to carry on the work the year round. It is a fact that the scientific gentlemen who have thus far been active in this work have donated their time and that their vacations have been given up to it, time they ought to have

devoted to getting a little fresh air into their lungs. But we find that the scientist is a very peculiar animal, that he enjoys spending his vacation in labor that is congenial to him; he does not seek to resort to the green field nor care to throw himself under the spreading branches of the oak and read a dime novel. His idea of recreation appears to be to get out and prosecute some independent and original work, all of which is very gratifying, I have no doubt, but unless some good systematic plan of work is adopted and carried on regularly, such work will be of little practical benefit to fish culture. Of course there are many collateral inquiries necessary, but we first ought to follow out the life history of the fish. The establishment of a good station for scientific study on the Great Lakes would probably result in a summer school such as we now have at Woods Hole. I think it is a matter of congratulation that something is now promised on the lakes similar to that now done on the ocean. In good hands and with permanent workers, eventually this work will redound to the benefit of fish culture, and I will welcome it as sincerely as anyone can.

Mr. Peabody: There was some talk last year of a convention of representatives of the States on the Great Lakes, regarding the matter of protection to the fisheries. Has anything been done?

Mr. Whitaker: That matter was left in the hands of the President. That information would more properly come from him.

Mr. Peabody: I would like to ask if the membership of this society is confined to residents of the United States. Its name is the American Fisheries Society; is there anything that would prevent securing members from abroad or in Canada?

Mr. Whitaker: No, America embraces it all.

Mr. Peabody: I don't know but it would be well to offer a resolution that the governors of the States bordering on the lakes appoint delegates to meet with this society at our meeting at Niagara Falls, and have them listen to the discussion regarding the ideas of fish culturists. Some of the governors of the States on the Great Lakes know nothing of this society. Can we not arrange in some way to have them meet with us? I don't know what has been done, but cannot something be done by which we can have that matter come to a head next summer at Niagara Falls?

Mr. Whitaker: I took occasion to write to Prof. Prince, of the Canadian Fishery Department, asking him to participate personally in this meeting, or by a paper. I never even received an acknowledgment of the letter.

Mr. Dale: Let Mr. Peabody as President and Mr. Whitaker as Secretary, issue a circular letter to the gentlemen living in Canada who are interested in fish culture, inviting them to attend the meeting in Niagara Falls.

President May: Do you want the society to take action on it at this time?

Secretary Whitaker: I will send an announcement of this meeting to those gentlemen.

Mr. Peabody: Now regarding the States bordering on the lakes, why wouldn't it be a good plan for the Secretary to communicate with the governors of those States, arranging for representatives from the lake States to attend the meeting at Niagara Falls?

Mr. Whitaker: Why not make a motion that the Secretary be authorized to communicate with the governors of all the States a sufficient time prior to the next meeting, calling their attention to this Society, its aims and objects and the desirability of having them appoint delegates to attend the meeting?

Mr. Peabody: I have drawn up and offer a resolution that the governors of all the States appoint delegates to be in attendance at the next meeting.

The resolution was supported and unanimously carried.

Secretary Whitaker: In that connection I want to say one word; the work in the office of Secretary is considerable, heretofore I have done all of it myself, this coming year I shall employ such force as is necessary; I think it is due the Society that I should state this.

Mr. Peabody: I will call for a resolution, providing that the Secretary be allowed $100.00.

Mr. Whitaker: I don't think that should be done.

Mr. Clark: I think the Secretary should have full power to use his judgment in those matters.

Mr. Whitaker: I shall not employ assistance except when it is necessary. I shall not abuse the privilege. The amount paid

out for running the office last year was about $50.00 to $55.00, and I did most of the work myself; this year I must have some assistance.

I wish to offer the following: This Society learns with pleasure that steps have been taken by the Commissioner of Fisheries of the United States to establish on the Great Lakes a permanent station for scientific inquiry. We recognize the importance and necessity of this work, and the practical bearing its investigations must have on many of the questions affecting fish culture and its success as an economic problem, therefore,

Resolved, That in the opinion of this Society the importance of this work is such, that we ask the Congress of the United States to grant the necessary funds to place this work upon a liberal and broad basis so that the work of the artificial propagation and distribution of the important food fishes of the lakes may be carried on with a thorough understanding and familiarity with the conditions surrounding the fisheries and their needs as will lead to the greatest success of that work.

Prof. Birge: I move the adoption of that resolution.

The resolution was unanimously carried.

Mr. Whitaker: I wish to say that I communicated to Mr. Fred. Mather the fact that at our last meeting he had been elected an honorary member of the Society and received a letter from him in reply in which he desired me to extend his thanks for the courtesy shown him and to express a due sense of his appreciation for the honor.

Mr. Clark: As there was a great deal of talk at the time we reduced the dues of getting a great many new members, which I have no doubt will be done, I would suggest that it might be a good idea for every one to get as many new members as they can and send their names to the Secretary between now and the time our report is ready to be sent out so that these new applicants may receive the report. Would not that be a good idea? I know I could send in the names of four or five that would want the book.

Mr. Whitaker: The Secretary last year on his own responsibility inaugurated that system. I held this out as an inducement to new members, that they would get the benefit of two years' membership for one year's dues.

There is another thing I want to give notice of. I shall bring up at the next meeting an amendment to the constitution.

The constitution as it now stands allows the names of delinquent members to stand on the rolls for three years. I shall move to amend by cutting it down to two years.

Mr. Dale: Before we adjourn I think we had better adopt a resolution of thanks to the officers of the Trans-Mississippi Exposition and the Mayor of the City of Omaha, for the courtesies extended to this Society at this meeting.

On motion Mr. Dale and Prof. Birge were appointel to present a suitable resolution of thanks to the officials of the City of Omaha, the Press and the Exposition officials for courtesies extended the Society, and they reported as follows:

Resolved, That the hearty thanks of the American Fisheries Society be extended to the Mayor of Omaha for the cordial welcome given the Society, through his secretary, and for the keys of the city, opening the doors of its hospitality, rendering our stay here both pleasant and profitable.

The thanks of the Society are also extended to the public press of Omaha for the excellent reports and notices of our meetings.

We desire to thank the officials of the Trans-Mississippi Exposition for the privilege extended to the members in attendance upon this meeting, of free admission to the exposition at all times. We congratulate the management upon the happy culmination of its efforts to present to the people of this country an exhibition which is only second to the Columbian Exposition in the beauty of its buildings and grounds, and upon the creation of such a magnificent exposition of the material resources and wealth of the giant west. Here, grouped about the Grand Central Court of Honor are buildings of rare architectural beauty filled with exhibits of industrial skill, of mineral wealth, and with the agricultural products of a territory laid down upon the maps of a quarter of a century ago as embraced in the great American desert, evidencing in a marked degree the fertility of a soil which only needs the hand of the husbandman to furnish proof of its inexhaustible resources. To the management which has conceived and brought forth so grand an achievement we feel that the highest praise is due.

On motion, the Society then adjourned to meet at Niagara Falls, N. Y., June 28th and 29th, 1899.

LIST OF MEMBERS.

ACTIVE.

Adams, E. W., 114 Wall st., New York.
Alexander, L. D., 50 Broadway, New York.
Alexander, Geo. L., Grayling, Mich.
Amsden, F. J., Rochester, N. Y.
Anderson, J. F., 240 Eleventh st., Jersey City, N. J.
Annin, Jas., Jr., Caledonia, N. Y.
Atkins, Chas G., East Orland, Me.
Ayer, F. W., Bangor, Me.
Babbitt, A. C., Sault Ste. Marie, Mich.
Babcock, C. H., Rochester, N. Y.
Ball, E. M., Put-in-Bay, O.
Barrett, W. W., Church's Ferry, N. D.
Bartlett, Dr. S. P., Quincy, Ill.
Bell, Currie G., Bayfield, Wis.
Belmont, Hon. Perry, 19 Nassau st., New York.
Benkard, James, Union Club, New York.
Bickmore, Prof. A. S., Am. Museum Natural History, New York.
Birge, Prof. E. A., Madison, Wis.
Bissell, J. H., Detroit, Mich.
Blackford, E. G., Fulton Market, New York.
Booth, A., cor. Lake and State sts. ,Chicago, Ill.
Bottemanne, C. J., Bergen op Zoom, Holland.
Bower, Seymour, Detroit, Mich.
Bowman, W. H., Rochester, N. Y.
Bradley, Dr. E., 19 West 30th st., New York.
Brice, Col. J. J., Mare Island Navy Yard, Cal.
Brush, Dr. E. F., Mount Vernon, N. Y.
Brown, Geo. M., Saginaw, Mich.
Bryant, E. E., Madison, Wis.
Bulkley, H. S., Odessa, N. Y.
Buller, N. R., Mauch Chunk, Pa.
Bumpus, Prof. H. C., Providence, R. I.
Cary, Dr. H. H., Lagrange, Ga.
Cheney, A. N., Glens Falls, N. Y.
Clark, Frank N., Northville, Mich.
Crook, Abel, 99 Nassau st., New York.
Crosby, H. F., P. O. Box No. 3714, New York.
Dale, J. A., York, Pa.
Davis, B. H., Palmyra, New York.
Davis, H. W., Grand Rapids, Mich.
Davis, Hon. G. B., Utica, Mich.
Demuth, H. C., 144 E. King st., Lancaster, Pa.
Dickerson, F. B., Detroit, Mich.

Douredoure, B. L., 103 Walnut st., Philadelphia, Pa.
Doyle, E. P., Port Richmond, N. Y.
Ebel, Hon. F. W., Harrisburg, Pa.
Ellis, J. F., U. S. Fish Commission, Washington, D. C.
Emerick, H. F., San Francisco, Cal.
Fox, J. C., Put-in-Bay, O.
Friesmuth, E. H., Jr., 151 North 3rd st., Philadelphia, Pa.
Frothingham, H. P., Mt. Arlington, N. J.
Gavitt, W. S., Lyons, N. Y.
Griffith, S. L., Danby, Vt.
Gunckel, J. E., Toledo, O.
Hagert, Edwin, 32 North 6th st., Philadelphia, Pa.
Haley, Caleb, Fulton Market, New York.
Hamilton, Robert, Greenwich, N. Y.
Hansen, G., Osceola Mills, Wis.
Harris, J. N., Fulton Market, New York.
Hartley, R. M., 627 Walnut st., Philadelphia, Pa.
Henshall, Dr. J. A., Bozeman, Mont.
Hessell, Dr. Rudolph, 1209 H st., Washington, D. C.
Hill, J. L., 115 Broadway, New York.
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